



PHYSICIAN REACTION TO PRICE CHANGES

Final Report

Submitted by:

Janet B. Mitchell, Ph.D., Project Director
Robert C. Boutwell, M.D., Ph.D.
A. James Lee, Ph.D.
William B. Stason, M.D.

June 1992

This report was submitted under the Health Care Financing Administration Physician Studies Indefinite Quantity Contract No. 500-89-0050, Delivery Order #3. The views and opinions expressed in this report are those of the authors and no endorsement by HCFA or DHHS is intended or should be inferred.

TABLE OF CONTENTS

	<u>PAGE</u>
1.0 INTRODUCTION	1-1
1.1 Statement of the Problem	1-1
1.2 Executive Summary	1-4
1.2.1 Technology Case Studies	1-4
1.2.2 Changes in Volume of Overpriced Procedures	1-5
1.2.3 Episode of Care Analysis	1-7
1.2.4 Design of Provider-Level Analysis	1-8
1.3 Overview of Report	1-10
2.0 METHODOLOGY FOR THE CASE STUDIES	2-1
1.1 Overview	2-1
1.2 Methods	2-1
3.0 BRONCHOSCOPY	3-1
3.1 Relevant Anatomy and Pathology	3-1
3.2 Indications for Bronchoscopy	3-2
3.3 Description of Procedure	3-2
3.4 Changes in Technology Affecting Risk/Benefit Ratio	3-3
3.5 Changes in Indications for Bronchoscopy	3-5
3.6 Shifts of Bronchoscopy to Ambulatory Settings	3-6
3.7 Development of Clinical Guidelines	3-6
3.8 Summary	3-8
REFERENCES	3-9
4.0 CARPAL TUNNEL RELEASE	4-1
4.1 Relevant Anatomy and Pathology	4-1
4.2 Indications for Carpal Tunnel Release	4-2
4.3 Description of Procedure	4-3
4.4 Changes in Technology Affecting Risk/Benefit Ratio	4-4
4.5 Changes in Indications for Carpal Tunnel Release	4-5
4.6 Shifts of Carpal Tunnel Release to Ambulatory Settings	4-5
4.7 Development of Clinical Guidelines	4-5
4.8 Summary	4-6
REFERENCES	4-7
5.0 CATARACT EXTRACTION	5-1
5.1 Relevant Anatomy and Pathology	5-1
5.2 Indications for Cataract Surgery	5-1
5.3 Description of Procedure	5-2
5.4 Changes in Technology Affecting Risk/Benefit Ratio	5-4
5.5 Changes in Indications for Cataract Extraction	5-6
5.6 Shifts of Cataract Surgery to Ambulatory Settings	5-7
5.7 Development of Clinical Guidelines	5-7
5.8 Summary	5-8
REFERENCES	5-9

TABLE OF CONTENTS (continued)

	<u>PAGE</u>
6.0 CORONARY ARTERY BYPASS GRAFT SURGERY	6-1
6.1 Overview	6-1
6.2 Relevant Anatomy and Pathology	6-1
6.3 Indications for CABG Surgery	6-2
6.4 Description of Procedure	6-3
6.5 Changes In Technology Affecting the Risk/Benefit Ratio	6-4
6.6 Changes in Indications for CABG Surgery	6-4
6.7 Development of Clinical Guidelines	6-5
6.8 Summary	6-6
REFERENCES	6-7
7.0 DILATATION AND CURETTAGE (D & C) OF UTERUS	7-1
7.1 Relevant Anatomy and Pathology	7-1
7.2 General Indications	7-1
7.3 Description of Procedure	7-2
7.4 Changes in Technology Affecting Risk/Benefit Ratio	7-2
7.4.1 Hysteroscopy	7-3
7.4.2 Endometrial Biopsy	7-3
7.5 Shifts of Procedures to Ambulatory Settings	7-5
7.6 Development of Clinical Guidelines for D & C	7-5
7.7 Summary	7-6
REFERENCES	7-7
8.0 TOTAL HIP REPLACEMENT (THR)	8-1
8.1 Relevant Anatomy and Pathology	8-1
8.2 Indications for Total Hip Replacement	8-2
8.3 Description of Total Hip Replacement	8-3
8.4 Changes in Technology Affecting Risk/Benefit Ratio	8-4
8.5 Changes in Indications for Hip Replacement	8-5
8.6 Shifts of Procedures to Ambulatory Settings	8-6
8.7 Development of Clinical Guidelines for Total Hip Replacement	8-6
8.8 Summary	8-6
REFERENCES	8-8
9.0 TOTAL KNEE REPLACEMENT (TKR)	9-1
9.1 Relevant Anatomy and Pathology	9-1
9.2 Indications for Total Knee Replacement	9-2
9.3 Description of Total Knee Replacement	9-3
9.4 Changes in Technology Affecting Risk/Benefit Ratio	9-4
9.5 Changes in Indications for Knee Replacement	9-4
9.6 Shifts of Procedures to Ambulatory Settings	9-5
9.7 Development of Clinical Guidelines for Total Knee Replacement	9-5
9.8 Summary	9-5
REFERENCES	9-6

TABLE OF CONTENTS (continued)

	<u>PAGE</u>
10.0 KNEE ARTHROSCOPY	10-1
10.1 Relevant Anatomy and Pathology	10-1
10.2 Indications for Knee Arthroscopy	10-1
10.3 Description of Knee Arthroscopy	10-2
10.4 Changes in Technology Affecting Risk/Benefit Ratio	10-4
10.5 Changes in Indications for Knee Arthroscopy	10-5
10.6 Shifts of Procedures to Ambulatory Settings	10-6
10.7 Development of Clinical Guidelines for Knee Arthroscopy	10-6
10.8 Summary	10-6
REFERENCES	10-7
11.0 PERMANENT CARDIAC PACEMAKER IMPLANTATION	11-1
11.1 Relevant Anatomy and Pathology	11-1
11.2 Indications for Permanent Cardiac Pacemaker Implantation	11-1
11.3 Description of Procedure	11-2
11.4 Changes in Technology	11-3
11.5 Changes in Indications for Pacemaker Implantation	11-5
11.6 Shifts of Procedures to Ambulatory Settings	11-6
11.7 Development of Clinical Guidelines for Pacemaker Implantation	11-6
11.8 Summary	11-7
REFERENCES	11-8
12.0 TRANSURETHRAL (TURP) AND SUPRAPUBIC PROSTATECTOMY (SP)	12-1
12.1 Relevant Anatomy and Pathology	12-1
12.2 Indications for Prostatectomy	12-2
12.3 Description of Prostatectomy	12-2
12.4 Transurethral Prostatectomy (TURP)	12-3
12.5 Suprapubic Prostatectomy	12-4
12.6 Complications	12-4
12.7 Changes in Technology Affecting Risk/Benefit Ratio	12-7
12.8 Changes in Indications for Prostatectomy	12-8
12.9 Shifts of Procedures to Ambulatory Settings	12-8
12.10 Development of Clinical Guidelines for Prostatectomy	12-8
12.11 Summary	12-9
REFERENCES	21-10
13.0 UPPER GI ENDOSCOPY	13-1
13.1 Relevant Anatomy and Pathology	13-1
13.2 Description of Procedure	13-2
13.3 Indications for Upper GI Endoscopy	13-3
13.4 Changes in Technology Affecting Risk/Benefit Ratio	13-4
13.5 Changes in Indications for Upper GI Endoscopy	13-6
13.6 Shift to Ambulatory Settings	13-6
13.7 Development of Clinical Guidelines for Upper GI Endoscopy	13-7
13.8 Summary	13-9
REFERENCES	13-10

TABLE OF CONTENTS (continued)

	<u>PAGE</u>
14.0 CHANGES IN VOLUME OF OVERPRICED PROCEDURES	14-1
14.1 Introduction	14-1
14.2 Methods	14-1
14.2.1 Study Design	14-1
14.2.2 Data Sources	14-2
14.2.3 File Construction	14-2
14.2.4 Calculation of Payment Change	14-4
14.3 Trends in Volume	14-5
14.3.1 Tabular Trends by Quarter	14-5
14.3.2 Testing the Volume Trends for Statistical Significance	14-8
14.4 Trends in Procedure Code Mix	14-10
14.5 Trends in Specialty Mix	14-12
14.6 Trends in Location of Service	14-13
14.7 Trends in Assignment Rates and Beneficiary Liability	14-13
14.7.1 Assignment Rates	14-13
14.7.2 Beneficiary Liability	14-14
14.8 Trends in Use of Assistant Surgeons	14-15
15.0 EPISODE OF CARE ANALYSIS	15-1
15.1 Analytic Approach	15-1
15.1.1 Variable Definitions	15-3
15.2 Procedure-Specific Results by Payment-Reduction Category	15-4
15.2.1 Cataract Extractions	15-5
15.3 Estimation of the Offset Effects	15-10
15.4 Changes in Practice Behavior of the Index Providers--Cataracts and CABGs	15-11
15.5 A Supplemental Test of the "Offset" Results	15-13
16.0 DESIGN OF A PROVIDER-LEVEL STUDY	16-1
16.1 Data Limitations	16-1
16.2 Assessment of the Medicare Data Alternatives	16-3
16.2.1 CHER's Multistate Data	16-3
16.2.2 BMAD Provider Files	16-4
16.3 Suggested Study Design	16-5

REFERENCES**APPENDIX A PARTICIPATING CONSULTANTS****APPENDIX B NUMBER OF PROCEDURES BY STATE**

TABLE OF TABLES

		<u>PAGE</u>
TABLE 14-1	CPT-4 CODE DEFINITIONS FOR STUDY OF OVERPRICED PROCEDURE REDUCTIONS	14-17
TABLE 14-2	PERCENT CHANGE IN MEAN RCL ALLOWED CHARGES, 1987-1988	14-18
TABLE 14-3	NUMBER OF REASONABLE CHARGE LOCALITIES BY SIZE OF PAYMENT CHANGE CATEGORY	14-19
TABLE 14-4	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TOTAL HIP REPLACEMENT	14-20
TABLE 14-5	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TOTAL KNEE REPLACEMENT	14-22
TABLE 14-6	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: KNEE ARTHROSCOPY	14-24
TABLE 14-7	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: BRONCHOSCOPY	14-26
TABLE 14-8	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: PERMANENT PACEMAKER INSERTION	14-28
TABLE 14-9	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY	14-30
TABLE 14-10	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: UPPER GI ENDOSCOPY	14-32
TABLE 14-11	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TRANSURETHRAL PROSTATECTOMY (TURP)	14-34
TABLE 14-12	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: SUPRAPUBIC PROSTATECTOMY	14-36
TABLE 14-13	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: DILATION & CURETTAGE (D & C)	14-38
TABLE 14-14	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CARPAL TUNNEL RELEASE	14-40
TABLE 14-15	QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CATARACT SURGERY	14-42
TABLE 14-16	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: TOTAL HIP REPLACEMENT	14-45
TABLE 14-17	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT	14-46

TABLE OF TABLES (continued)

		<u>PAGE</u>
TABLE 14-18	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: KNEE ARTHROSCOPY	14-47
TABLE 14-19	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: PERMANENT PACEMAKER INSERTION	14-48
TABLE 14-20	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY	14-49
TABLE 14-21	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: UPPER GI ENDOSCOPY	14-50
TABLE 14-22	CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: CATARACT SURGERY	14-51
TABLE 14-23	CHANGES IN SPECIALTY MIX BY SIZE OF PAYMENT REDUCTIONS: BRONCHOSCOPY	14-52
TABLE 14-24	CHANGES IN SPECIALTY MIX BY SIZE OF PAYMENT REDUCTIONS: UPPER GI ENDOSCOPY	14-53
TABLE 14-25	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY	14-54
TABLE 14-26	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY	14-55
TABLE 14-27	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: UPPER GI ENDOSCOPY	14-56
TABLE 14-28	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)	14-57
TABLE 14-29	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE	14-58
TABLE 14-30	CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY	14-59
TABLE 14-31	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT	14-60
TABLE 14-32	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT	14-60
TABLE 14-33	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY	14-60
TABLE 14-34	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY	14-61
TABLE 14-35	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: PERMANENT PACEMAKER INSERTION	14-61

TABLE OF TABLES (continued)**PAGE**

TABLE 14-36	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY	14-61
TABLE 14-37	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: UPPER GI ENDOSCOPY	14-62
TABLE 14-38	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TRANSURETHRAL PROSTATECTOMY (TURP)	14-62
TABLE 14-39	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)	14-62
TABLE 14-40	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE	14-63
TABLE 14-41	CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY	14-63
TABLE 14-42	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT	14-64
TABLE 14-43	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT	14-64
TABLE 14-44	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY	14-65
TABLE 14-45	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY	14-65
TABLE 14-46	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: PERMANENT PACEMAKER INSERTION	14-66
TABLE 14-47	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY	14-66
TABLE 14-48	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: UPPER GI ENDOSCOPY	14-67
TABLE 14-49	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TRANSURETHRAL PROSTATECTOMY (TURP)	14-67
TABLE 14-50	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)	14-68
TABLE 14-51	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE	14-68
TABLE 14-52	CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY	14-69

TABLE OF TABLES (continued)

		<u>PAGE</u>
TABLE 14-53	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT	14-70
TABLE 14-54	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT	14-70
TABLE 14-55	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY	14-70
TABLE 14-56	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: PERMANENT PACEMAKER INSERTION	14-71
TABLE 14-57	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY	14-71
TABLE 14-58	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE	14-71
TABLE 14-59	CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY	14-72
TABLE 15-1	PROCEDURE GROUP SAMPLE SIZES	15-16
TABLE 15-2	AVERAGE PERCENTAGE PRICE CHANGES, 1987-1988	15-17
TABLE 15-3	EPISODE OF CARE SUMMARY FOR CATARACT EXTRACTION, 1986-1989	15-18
TABLE 15-4	EPISODE OF CARE SUMMARY FOR TOTAL HIP REPLACEMENT, 1987-1989	15-19
TABLE 15-5	EPISODE OF CARE SUMMARY FOR TOTAL KNEE REPLACEMENT, 1987-1989	15-20
TABLE 15-6	EPISODE OF CARE SUMMARY FOR CABG SURGERY, 1987-1989	15-21
TABLE 15-7	EPISODE OF CARE SUMMARY FOR UPPER GI ENDOSCOPY, 1987-1989	15-22
TABLE 15-8	EPISODE OF CARE SUMMARY FOR PROSTATECTOMY, 1987-1989	15-23
TABLE 15-9	COMPARISON OF "HIGH" VERSUS "LOW" IMPACT GROUPS, 1987-1989	15-24
TABLE 15-10	CHANGES IN THE INDEX PROVIDER'S BILLING OF SELECTED NONINDEX PROCEDURES, CATARACT, 1986-1989	15-25
TABLE 15-11	CHANGES IN THE INDEX PROVIDER'S BILLING OF SELECTED NONINDEX PROCEDURES, CABG, 1987-1989	15-26
TABLE 15-12	ΔQ -REGRESSION MODELS, 1987-1989	15-27

TABLE OF TABLES (continued)

		<u>PAGE</u>
TABLE 15-13	TWO ALTERNATE ESTIMATES OF THE "OFFSET" PERCENTAGES	15-28
TABLE 16-1	NUMBERS OF SOLO PRACTICE PHYSICIANS MATCHED BY CARRIER, 1986 TO 1989, BMAD PROVIDER FILE	16-9
TABLE 16-2	NUMBERS OF SOLO PRACTICE PHYSICIANS MATCHED BY SPECIALTY, 1986 TO 1989, BMAD PROVIDER FILE	16-10

TABLE OF FIGURES

		<u>PAGE</u>
FIGURE 14-1	VOLUME TRENDS FOR TOTAL HIP REPLACEMENT	14-21
FIGURE 14-2	VOLUME TRENDS FOR KNEE REPLACEMENT	14-23
FIGURE 14-3	VOLUME TRENDS FOR KNEE ARTHROSCOPY	14-25
FIGURE 14-4	VOLUME TRENDS FOR BRONCHOSCOPY	14-27
FIGURE 14-5	VOLUME TRENDS FOR PACEMAKER INSERTION	14-29
FIGURE 14-6	VOLUME TRENDS FOR CABG SURGERY	14-31
FIGURE 14-7	VOLUME TRENDS FOR UPPER GI ENDOSCOPY	14-33
FIGURE 14-8	VOLUME TRENDS FOR TURP	14-35
FIGURE 14-9	VOLUME TRENDS FOR SUBRAPUBIC PROSTATECTOMY	14-37
FIGURE 14-10	VOLUME TRENDS FOR D & C	14-39
FIGURE 14-11	VOLUME TRENDS FOR CARPAL TUNNEL RELEASE	14-41
FIGURE 14-12	VOLUME TRENDS FOR CATARACT SURGERY	14-43
FIGURE 14-13	MODEL OF STATISTICAL TEST FOR VOLUME CHANGE	14-44

1.0 INTRODUCTION

1.1 Statement of the Problem

For nearly 25 years, Medicare has reimbursed physicians using the "customary, prevailing, and reasonable" (CPR) methodology which calculates payment rates from current and historical charge patterns in local geographic areas. As part of the Omnibus Budget Reconciliation Act of 1989, however, Congress has fundamentally altered the method of physician payment under Medicare. A fee schedule will replace the CPR methodology with a fixed fee per service, regardless of historical charges. The fees themselves, furthermore, will be based on the Resource-Based Relative Value Scale (RBRVS) developed by Hsiao and colleagues and refined by the Physician Payment Review Commission and HCFA.

The Medicare Fee Schedule (MFS) redresses a major perceived inequity in the current Medicare payment system: that the CPR methodology "overpays" technical procedures like surgery, while "underpaying" other services, like visits. By basing payments on relative work effort, the new fee schedule will increase fees for visits and lower fees for many surgeries and diagnostic tests. The implications of this change for physicians' Medicare revenues are substantial. Simulations performed by HCFA have shown substantial declines for surgeons and radiologists, with corresponding increases for general and family practitioners (DHHS, 1991). Nothing is known, however, about how physicians may respond to the new fee schedule. Of particular concern is how surgeons will respond to the payment reductions, which can be as high as 35 percent for some procedures. Will surgeons see fewer Medicare patients, or stop treating them altogether? Or will surgeons provide even more procedures in order to maintain target incomes? Or will beneficiaries themselves demand more procedures in response to the price cuts? The answer to these questions will have important implications for both beneficiary access and program outlays.

Previous research suggests that fee freezes or outright fee reductions may lead to increased program costs. Gabel and Rice (1985) summarized the evidence from natural experiments involving such fee changes and concluded that physicians responded by increasing the quantity provided (including more surgery). In a recent reanalysis of data from

one of the studies reviewed (Rice and McCall, 1984), the Congressional Budget Office concluded that physicians faced with fee reductions would "make up" at least one-half of the revenue loss through volume increases (CBO, 1989).

These natural experiments are limited in their ability to disentangle patient-induced from physician-induced demand as alternative responses to fee reductions. Nevertheless, the availability of supplemental coverage for most Medicare beneficiaries would seem to attenuate (if not eliminate) patient demand as an important factor. Econometric studies, furthermore, have found definite evidence of inducement in the case of surgery (Cromwell and Mitchell, 1986; Fuchs, 1978), although not for office visits (McCarthy, 1985; Wilensky and Rossiter, 1981).

In addition, previous research has generally examined physician responses either to fee freezes or to relatively small payment reductions; under the new fee schedule, reductions for many high-volume Medicare operations will be on the order of 20-30 percent. Knowing how physicians may respond to cuts of this magnitude will help policymakers estimate future program outlays. The fee schedule itself will not be fully implemented for some time; phase-in began in January 1992, but will not be completed until January 1996. However, payment reductions on "overpriced" procedures have already taken place, providing an opportunity to study physician reactions right now.

As part of OBRA-86, prevailing charges for cataract surgery were reduced 10 percent, subject to a 75 percent floor, i.e. no charge could be reduced to less than 75 percent of the national average prevailing charge. This overpriced procedure reduction went into effect January 1, 1987. In OBRA-87, Congress introduced a more sophisticated approach that reduced prevailing charges disproportionately more in high-fee areas, and they applied it to a much larger group of procedures. Those procedures included total hip replacement, total knee replacement, knee arthroscopy, bronchoscopy, pacemaker insertion, CABG surgery, upper GI endoscopy, transurethral and suprapubic prostatectomy, D and C, carpal tunnel release, and (again) cataract surgery. Briefly, the reduction formula worked as follows. Prevailing charges for these procedures did not receive the 1988 MEI update; instead the 1987 prevailings were reduced by 2 percent. A sliding scale formula was then applied that further reduced each charge, based on its relationship with the national average. The higher the area

prevailing relative to the national prevailing, the greater the reduction made to the area prevailing (with a maximum possible reduction of 15%). In no case was an area prevailing allowed to fall below a floor that was set at 85 percent of the national average. These reductions went into effect on April 1, 1988.

The result of the OBRA-87 formula was a potentially wide range in the size of the payment reductions across the country. The size of the reductions varied across geographic areas, across specialties, across the procedures themselves, and even across individual physicians performing the same procedure in the same area (this last will occur to the extent that allowed charges are not all at the prevailing). This cross-sectional variation will be very useful in evaluating physician responses from what would otherwise be a simple pre-post design.

The purpose of this project was to measure the volume changes (if any) that followed the overpriced procedure reductions. In particular, we want to compare changes in use rates as a function of the size of the reduction. Additionally, we sought to describe each of the surgical procedures themselves, with special attention to recent technological changes. It should be noted that this project sought to examine only two of the many possible volume changes that could accompany fee reductions, i.e., changes in the number of operations and in the number of associated procedures. In both cases, we focussed on only those twelve procedure groups whose payments were reduced; we did not examine whether physicians increased or decreased their supply of other services.

In addition, this study only examined aggregate volume changes, i.e. changes calculated at the area level. It is possible that some physicians responded to price changes by increasing supply while others responded by reducing the supply of surgical procedures, leaving the area totals unaffected. Ideally, studies of physician response to price changes would be based on physician-level data; unfortunately, individual physicians could not be identified from the available claims data.

A final caveat has to do with the generalizability of this study to the Medicare Fee Schedule. OBRA-87 reduced the prices of only twelve groups of surgical procedures; by contrast, the new fee schedule changes the relative prices of all services, both surgical and non-surgical. It would thus be reasonable to expect that any physician response to price changes would be larger (in absolute terms) under MFS than under OBRA-87.

1.2 Executive Summary

This project contained two major components: (1) the production of "case studies" describing each of the twelve surgical procedures; and (2) Part B claims analysis. The claims analysis portion of the project sought to capture two of the many possible changes associated with the overpriced procedure payment reductions: changes in the volume of the overpriced procedures themselves, and changes in the number of services provided during an episode of care associated with an overpriced procedure. Each potential change was analyzed using a different data base.

1.2.1 Technology Case Studies

For each of the twelve procedures, we produced a "technology case study", that can be easily read and understood by policymakers without clinical backgrounds. Each case study begins with an overview of the relevant anatomy and disease processes, and is followed by a description of the surgical procedure itself, general indications for its performance, and possible complications. We then analyze those technological changes which occurred during the 1980's and which may have influenced the utilization of these procedures independent of the reimbursement change. These technological changes were grouped into four categories:

- changes in technology which altered the risk/benefit ratio for a procedure;
- application of existing technologies to a broader range of clinical conditions (i.e. changes in clinical indications);
- shifts of procedures to ambulatory settings; and
- development of physician practice guidelines which fostered wider, or more limited, use of a technologically stable procedure.

Independent reports were written on each procedures, based on extensive literature review and interviews with outside consultants in the relevant physician specialties. The resulting case studies provide a qualitative framework for evaluating observed trends in the volumes of the twelve procedures.

1.2.2 Changes in Volume of Overpriced Procedures

A quasi-experimental design was used that took advantage of the natural geographic variation in the fee reductions. If surgeons responded to the OBRA cuts by changing the number of procedures they provided, then those changes should be correlated with the size of the payment reduction, i.e. larger volume changes should follow larger payment reductions. Claims data were available for all overpriced procedures provided in eleven states over a five-year time period, 1985-1989. The OBRA payment change was defined as the change in the average allowed charge from 1987 to 1988 (or 1986-1988, in the case of cataract surgery). All variables were measured at the individual carrier-reasonable charge locality level (49 localities in all).

As expected, considerable variation in payment changes were observed across localities. Ten localities experienced payment reductions of 5 percent or more for total knee replacement, for example, with one receiving the maximum reduction of 15 percent. At the same time, 12 areas received increases in knee replacement reimbursement, as high as 29 percent in one locality. (Reimbursement increases could occur since our payment change measure is based on allowed, rather than prevailing, charges.) The remaining 27 localities, however, experienced only minor payment reduction (less than 5%).

While the OBRA payment reductions did result in varying payment changes across areas, the average changes were quite modest, ranging from -5.3 percent in the case of cataract surgery to +3.5 percent for suprapubic prostatectomy. (The average for total knee replacement was -2.1%.) These payment changes were thus considerably smaller than those anticipated under the MFS, and possibly too small to engender any behavioral responses on the part of physicians.

Localities were categorized based on the size of their payment change: large (5% or more), small (less than 5%) and no change or increase. Volume trends (procedures per locality) were then tracked over the 20 quarters of the study period. All data were weighted by the number of Medicare enrollees living in the locality.

For most of the overpriced procedures, there appeared to be no systematic relationship between volume trends and the size of the payment change. In a few cases (notably hip and knee replacements and cataract surgery), the tabular data suggested that rates of growth

actually slowed in areas with relatively larger payment reductions. These trends were difficult to interpret, however, as volume levels were much higher in areas experiencing payment reductions, compared with the "no change/increase" group. This correlation of volume with payment change category makes trend comparisons particularly difficult. Many of the overpriced procedures are "one-time", or non-recurring operations, at least over our relatively short study period. This means that high-volume areas will be unable to sustain high growth rates indefinitely, as the market becomes saturated and surgeons exhaust the available patient pool.

We used time-series analysis in order to test the statistical significance of any volume changes resulting from the OBRA payment reductions, while controlling for both initial levels of use and secular time trends. We were unable to reject the null hypothesis; there was no statistical evidence that the volume of these procedures changed (in any direction) as a result of OBRA-87.

While we found no evidence of behavioral response (either positive or negative), caution should be exercised in generalizing these results to volume changes under the Medicare Fee Schedule. First of all, the average payment reductions enacted under OBRA-87 were far smaller than those anticipated under the MFS. Second, while there was an average of about 900 observations for each time-series analysis, we may have still lacked the statistical power to detect any effects. The maximum number of unique localities was only 49, and substantial inter-area variation in surgical volume was observed, even within payment change category. The use of an econometric model could have helped us to adjust for demand and supply factors affecting volume, and to better isolate an OBRA effect.

Our tabular analyses did show, however, that beneficiaries enjoyed increasing financial protection over this time period. This protection was largely due to the balance billing limitations accompanying OBRA, rather than the reduced copayments associated with lower fees.

Besides volumes and out-of-pocket liability, we also examined trends in procedure code mix, specialty, location of service, assignment rates, and the use of assistant surgeons. Observed trends were consistent with technological changes and Medicare program changes such as PRO review and the participating physician program. There were no systematic relationships between these trends and the size of the OBRA payment reductions.

1.2.3 Episode of Care Analysis

Physicians may respond to fee reductions in a variety of ways. The potential for an increase in procedure volume has received the greatest attention. However, physicians may also respond in other ways that similarly lead to increased outlays. Examples include the following: greater use of surgical assistance; more testing; provision of more "incidental" procedures; and fragmentation of billings.

In order to investigate the importance of such "offsetting" effects, the episode-of-care analysis examined the overall pattern and cost of health care services provided in association with surgical procedures impacted by fee reductions. The study focused on the following six procedure groups: cataract extractions, total hip replacement, total knee replacement, CABG surgery, upper GI endoscopy, and prostatectomy. HCFA's five percent BMAD beneficiary files were used to construct episode-of-care records for over-priced procedures in four years, 1986 through 1989. The data for each "index" procedure (i.e., a procedure impacted by the fee reduction) were organized into three observational periods:

Period I--the 30-day interval prior to surgery;

Period II--the day of surgery (plus the hospital claim, if any); and

Period III--the 90-day interval subsequent to surgery.

In addition, a fourth observational interval (Period IV) was defined as being the entire study interval, accumulating experience for Periods I, II and III.

In order to distinguish potential "treatment effects," the 1986-1989 changes in the content of the surgical "episodes" were analyzed in three groups. These groups were designed to reflect varying intensities of the price impacts (low, medium and high price changes) and were defined from carrier-level changes in the allowed charge for each procedure.

For each procedure group, a high impact group was defined to include those carriers with the highest percentage price decreases (or, equivalently, the lowest percentage price increases) accounting for approximately a third of the procedures included in the study. For each procedure group, a low impact group was analogously taken as being those carriers with the lowest percentage payment reduction (i.e., the highest percentage price increases),

accounting for a second third of study procedures. Finally, those carriers accounting for the remaining middle third of the procedures were considered to constitute the intermediate or medium price change group. This design gave approximately equal numbers of procedures in each of the three analytic groups, helping to avoid mistaken inference due to disproportionate and small sample sizes.

Only two of the six procedure groups included in the study--cataract extractions and CABG surgery--gave significant evidence for the existence of a service volume offset to the fee reductions. The percentage offsets estimated for cataract extractions and CABG surgery, were, respectively, 38 percent and 30 percent. Our findings with respect to the four other surgical procedures included in the study were not statistically significant.

While a serious econometric investigation was not conducted, the available data were also used to conduct a simple multivariate test, one which clearly supports and substantially validates the offset findings obtained from heuristic comparison of the high and low impact groups. Finally, for the two procedure groups indicating significant offset effects, we also distinguished the other procedures that appeared to be responsible for the offsets.

1.2.4 Design of Provider-Level Analysis

The analyses described above examine the impact of overpriced procedure reductions on two criteria: (1) the volume of overpriced procedures and (2) the volume and cost of other services provided in association with the overpriced procedures. A final task was to design, but not actually implement, a study that would investigate still other impacts on physician practice behavior. The nature of *individual* physician response to the overpriced procedure reductions is unquestionably the crux of the problem.

Ideally, one would pursue a provider-level analysis which observes how the practice patterns of individual physicians change in response to their specific or personal fee reductions. Such a provider-level analysis would enable us to more reliably specify and estimate the behavioral relationship between fee reductions and changes in procedure volume. For example, a physician who relies on an overpriced procedure for 50 percent of his or her practice revenue may be expected to respond very differently to a given fee reduction than one who derives only five percent of revenues from the procedure.

Provider-level claims data would, in addition, permit analysis of changes in the procedure mix at the complete practice level. For example, we would like to know to what extent surgical practices reduce the number of overpriced procedures, but increase the number of close substitutes not subject to fee reductions? An example would be a thoracic surgeon who substitutes PTCA for CABG surgery.

Also, with sufficient data, a provider-level analysis could detect changes in the payor mix. For example, we would like to know to what extent physicians switch their practices and shift costs from Medicare to non-Medicare patients? Have ophthalmologists, for example, responded to the fee reduction by providing more cataract surgery to non-Medicare patients?

The value of pursuing a provider-level analysis is unfortunately mitigated by two key Medicare data problems:

- (1) it is impossible to determine the services that physicians provide to their non-Medicare patients; and
- (2) it is extremely difficult to distinguish the services that individual physicians provide to Medicare patients.

Apart from a special study, it is simply not feasible to obtain provider-specific information on the universe of care provided to non-Medicare patients. While not impossible, it is also difficult, using historical data, to obtain dependable information on the universe of care provided to Medicare patients on a provider-specific basis.

After consideration of the various data alternatives and problems, we recommend a two-pronged strategy for conducting a provider-level analysis of the surgical fee reductions:

- (1) use 100 percent data for Kansas and Alabama to distinguish effects on both solo and group practice providers in those states; and
- (2) use the 5 percent BMAD provider files to distinguish the effects on a larger universe of solo practice providers.

Finally, if the results from (1) and (2) above are sufficiently robust, one may combine them with other provider distributional parameters (e.g., percent of care provided by group practices) from BMAD to generalize or extrapolate study findings to the entire country.

1.3 Overview of Report

The remainder of this report consists of 15 chapters. The twelve case studies are presented in Chapters 2 through 13. Chapter 14 presents the analysis of trends in procedure volume, while the episode of care analyses are provided in Chapter 15. Chapter 16 describes how provider-level analyses might be designed to better test for volume changes associated with payment reductions. The appendix at the end of the report provides summary tables of the number of overpriced procedures by state and year. A second technical appendix is included as a separate volume. This appendix provides extensive detail on data from the episode of care analysis.

2.0 METHODOLOGY FOR THE CASE STUDIES

2.1 Overview

The research question addressed by this project was whether physicians, as a response to these price cuts, reduced services to Medicare beneficiaries, or whether they performed even more procedures on Medicare patients in order to maintain target incomes. However, non-price factors may also affect utilization rates of surgical procedures. In the following 12 chapters, we explore some of these non-price factors for each of the twelve procedures whose reimbursement was reduced by OBRA-86 and OBRA-87. Our intent has been to produce for each procedure a "technology case study" which is accessible to health policymakers without clinical backgrounds. Therefore, each case study begins with an overview of relevant anatomy and disease processes, and is followed by a description of the surgical procedure, general indications, and possible complications. Finally, we analyze the technological changes which occurred in the 1980s which may have influenced utilization of these procedures during the 1985-1989 study period. These technological changes have been grouped into four categories:

- changes in technology which altered the risk/benefit ratio for a procedure;
- application of existing technologies to a broader range of clinical conditions (i.e., changes in clinical indications);
- shifts of procedures to ambulatory settings; and
- development of physician practice guidelines which fostered wider, or more limited, use of a technologically stable procedure.

2.2 Methods

For each of the twelve procedures, an on-line search was performed of the National Library of Medicine's bibliographic databases, using GRATEFUL MED software. Relevant references from the on-line search were obtained from the Countway (Harvard Medical School) Library, and were reviewed by our two staff physicians, Drs. Boutwell and Stason (an internist and cardiologist, respectively). In addition, the American Medical Association and medical specialty societies were contacted to obtain practice guidelines and policy statements relevant to the twelve procedures.

Our two physicians then prepared outlines from the published literature and from available guidelines, summarizing the important clinical and technological issues for each procedure. Consultants from appropriate medical and surgical specialties were selected based on suitable clinical experience, affiliation with teaching hospitals and medical schools, and demonstrated interest in health policy issues. The specialties represented included: cardiology, gastroenterology, obstetrics-gynecology, ophthalmology, orthopedic surgery, pulmonary medicine, and urology. We conducted extensive telephone interviews with our consultants to clarify the issues and questions identified through literature review. A technology case study was then written for each of the twelve procedures, based on the literature review and the telephone interviews. It is important to note that our consultants did not have an opportunity to review the written case studies. Their participation in this project should not, then, be taken as an endorsement of the final written form of the case studies. However, a list of consultants who participated in the interview stage of this process is included as Appendix A.

3.0 BRONCHOSCOPY

3.1 Relevant Anatomy and Pathology

The large airway below the larynx is the *trachea*, a single passage stiffened by cartilage. The trachea divides into the right and left mainstem *bronchi*. These two mainstem bronchi form a *bronchial tree*, by branching first into several *lobar bronchi*, then into *segmental* and *subsegmental bronchi*, *terminal bronchioles*, *respiratory bronchioles*, and finally *alveolar ducts*. The bronchial tree delivers inspired air to the sac-like functional units (*alveoli*) of the lung where gas exchange takes place between circulating blood and the external environment.

The bronchial tree, down to the level of the terminal bronchioles, contains several specialized components, including mucous-secreting cells, muscle cells, nerve endings, and hair-like projections called *cilia*. Inhaled particles are trapped by mucous secretions, and the mucous is continuously swept upwards toward the throat by cilia. Chronic exposure to irritants such as smoke often increases mucous production, but damages or eliminates the cilia, thus decreasing the clearance of mucous from airways. Muscle cells in the bronchial tree cause bronchial constriction or bronchospasm in response to a number of stimuli, including mechanical or chemical irritants, infection, and inflammation. Nerve endings in the bronchial tree, in response to these same factors, can stimulate a cough reflex.

Some common disorders affecting the bronchial tree are inflammation and infection (acute bronchitis); bronchospasm (asthma); obstruction of airways by excessive mucous (chronic bronchitis, chronic obstructive pulmonary disease or COPD); and primary cancer arising in the bronchial lining. Some common disorders affecting the alveoli (the gas-exchanging units of the lung) are infections (pneumonia); inflammation (pneumonitis); and destruction of alveolar walls (emphysema). Cough, increased mucous production, and *hemoptysis* (coughing up blood) are non-specific symptoms that can be found with most of these disorders.

3.2 Indications for Bronchoscopy

Common indications for diagnostic bronchoscopy are to investigate chronic unexplained symptoms such as coughing or hemoptysis, to determine the cause of abnormal markings on chest X-ray, and to diagnose puzzling inflammatory and infectious conditions. Bronchoscopy has also been used therapeutically to retrieve small inhaled objects (a problem more frequently observed in small children than in adults), to remove thick mucous plugs not loosened by medications, and to assist occasionally in the placement of endotracheal tubes in patients requiring mechanical ventilation.

3.3 Description of Procedure

A fiberoptic bronchoscope is a long thin tube containing flexible glass fibers (fiber optics) and two or more channels used for instrumentation and suctioning. From an external source, light travels down the glass fibers to illuminate the area under examination. Reflected light travels up the glass fibers again, presenting an image to the examining physician.

During the procedure, the tip of the bronchoscope is introduced into the patient's nose or mouth, and passed through the throat and larynx into the trachea. The bronchial tree is a highly branched structure, and an extensive bronchoscopic examination requires advancing and withdrawing the instrument repeatedly to enter different parts of the bronchial tree. Abnormalities seen with the bronchoscope may be sampled in several ways: by "washing" the area with a small amount of liquid and suctioning the fluid back out (*bronchial wash*); by scraping the surface of the abnormal area with a wire-controlled brush (*bronchial brush*); by biopsying the bronchial lining or surrounding tissue using wire-controlled forceps (*endobronchial* or *transbronchial biopsy*); and by inserting a needle through the bronchial wall into lymph nodes or alveolar tissue (*transbronchial needle aspiration*). Tissue samples obtained through any of these methods are sent for pathological examination and

may also be cultured for bacteria and other pathogens. In some cases, fluoroscopy may be used to guide the biopsy forceps or needle to an abnormality identifiable on chest x-ray.

Bronchoscopy is performed with local anesthesia to reduce or eliminate gagging when the bronchoscope is passed through the throat. Many bronchoscopists (who are nearly always pulmonary specialists or thoracic surgeons) also use intravenous sedation to reduce anxiety; however, patients remain conscious throughout the procedure. Patients must fast for 12 hours before bronchoscopy to prevent vomiting and aspiration of gastric contents. Bronchoscopy is commonly performed as an ambulatory procedure, and most patients can be discharged to home within a few hours.

Decreased respiration and oxygenation (*hypoxia*) are the most common complications of bronchoscopy for several reasons: all patients have chronic or acute respiratory disease (such as bronchospasm or obstruction); ventilation is impaired somewhat by the presence of the bronchoscope in the bronchial tree; the bronchoscope itself can induce bronchospasm by mechanical irritation; and intravenous drugs given to reduce anxiety can reduce respiratory drive as well. Many patients also have cardiac disease, and cardiac arrhythmias during bronchoscopy are not uncommon. However, serious respiratory and cardiac complications can be minimized by monitoring of blood oxygen levels and cardiac rhythm.

Transbronchial biopsy and needle aspiration pose two additional risks: bleeding and *pneumothorax* (introduction of air into the chest cavity surrounding the lung). These complications are rarely life-threatening, but require additional observation and perhaps intervention.

3.4 Changes in Technology Affecting Risk/Benefit Ratio

One significant technological improvement has been a reduction in the diameter of bronchoscopes. Many pulmonary specialists are now regularly using bronchoscopes that are one-third smaller than those of five or ten years ago. These smaller scopes improve the risk-benefit ratio of bronchoscopy in several ways. They are less likely to cause hypoxia since

they obstruct the airway less. They can also be maneuvered further out in the bronchial tree, to the level of subsegmental bronchi, increasing the number of abnormalities that can be examined bronchoscopically. Finally, smaller scopes are somewhat better tolerated by patients since the sensation of pressure in the throat is less.

For those patients who do receive intravenous sedation for bronchoscopy, the introduction of Versed in 1986 offered some advantages. The drug takes effect very quickly but has a shorter half-life than Valium, the drug it replaced. Patients therefore recover from sedation more rapidly. Moreover, administration of Versed usually causes a brief period of amnesia without loss of consciousness; most patients who receive Versed will remember little or nothing of the procedure. An important disadvantage of Versed, however, is that it may cause decreased respiration more frequently, especially when used in doses equivalent to that of Valium. Greater experience with Versed, and downward adjustment of doses, have reduced this risk.

The risk-benefit ratio has also been improved by the use of videoscopes, a technology that was diffusing in the late 1980s. Images can now be viewed on video screens, rather than through small telescope-like lenses. The larger image improves diagnostic accuracy. Clinical teaching is more effective, since all participants view the same image simultaneously. Quality of care may also improve, since diagnostic findings and therapeutic maneuvers can be videotaped and reviewed later. The advantages of videoscope technology, however, may be limited largely to teaching hospitals due to its high cost.

The benefits of bronchoscopy have also recently expanded to include therapy as well as diagnosis of bronchogenic cancer. In *brachytherapy*, a radioactive wire is inserted in the bronchus via bronchoscopy and left in place for several hours; the procedure can be used in place of, or as an adjunct to, external radiation therapy to shrink an obstructing tumor. Bronchoscopic laser therapy has also been available clinically for about five years to reduce the bulk of bronchial tumors. Both of these bronchoscopic treatments are palliative rather than curative.

3.5 Changes in Indications for Bronchoscopy

The availability of bronchoscopic therapies such as brachytherapy and laser ablation of tumors has had relatively little impact on overall utilization rates. Most bronchoscopy is performed for diagnostic purposes.

The use of smaller-diameter bronchoscopes has meant that patients with abnormalities located more peripherally in the bronchial tree can now benefit from diagnostic bronchoscopy. Increased use of transplantation, and consequently of immunosuppressive therapy, has also increased the pool of individuals requiring bronchoscopy: many of these patients will undergo repeated procedures to look for evidence of inflammatory reactions in the lung that accompany organ rejection, or to diagnose opportunistic pulmonary infections associated with immunosuppression. (Patients with AIDS are also likely to undergo diagnostic bronchoscopy; however, few AIDS patients are covered by Medicare.)

Bronchoscopy has found another application in intensive care patients on mechanical ventilators. Ventilators deliver air to the lungs through endotracheal tubes, which are inserted through the mouth into the trachea. A cuff at the bottom of the tube is inflated against the tracheal wall, so that air can be forced into the lungs through the tube without leaking. It is critical that the end of the tube be properly positioned in the trachea below the larynx and not in the right or left main-stem bronchus, so that both lungs are ventilated. A radio-opaque stripe runs down the length of all endotracheal tubes, so that their position can be checked by chest X-ray after placement. Bronchoscopy occasionally must be used to place such tubes properly. However, the procedure is being used increasingly in intensive care units to check the position of endotracheal tubes immediately after routine (non-bronchoscopic) placement, rather than wait until a portable X-ray machine can be brought to the intensive care unit. In some cases, both bronchoscopy and chest X-rays are used to determine the position of the tube; either procedure is sufficient, and chest X-ray is usually less expensive.

3.6 Shifts of Bronchoscopy to Ambulatory Settings

Since 1985, the usual location of bronchoscopy has shifted from inpatient to ambulatory settings. Most procedures are now done in ambulatory surgical units located within hospitals, where patients can be observed for several hours following the procedure. No significant technical breakthroughs were necessary for this shift; rather, it is more likely attributable to increased pressure from payors, and to increased experience and confidence of physicians in their ability to recognize complications. Today, the only patients likely to be admitted for bronchoscopy are those at increased risk from medical conditions such as recent myocardial infarction; unstable cardiac arrhythmias; and marginal lung function with increased risk for respiratory failure (especially if intravenous sedation is used). Patients who experience complications during bronchoscopy (such as significant hemoptysis or pneumothorax) are also admitted.

3.7 Development of Clinical Guidelines

In 1986, the American Thoracic Society (ATS) published its "Guidelines for Fiberoptic Bronchoscopy in Adults." The guidelines are concise and enumerate both diagnostic and therapeutic indications for bronchoscopy. They also list a number of conditions in which hospital admission for bronchoscopy may be necessary. The guidelines reflected the common practice of well-trained pulmonary specialists, and were not controversial.

However, more detailed statements would have been helpful regarding the appropriateness of diagnostic bronchoscopy in several clinical conditions. For example, the procedure is frequently used to establish or exclude the diagnosis of cancer when the patient's chest X-ray shows new suspicious abnormal densities. Even when the chest X-ray abnormalities are entirely consistent with pneumonia or atelectasis (localized collapse of lung tissue), the possibility remains (although usually remote) that an unseen tumor is contributing to the pneumonia or atelectasis by obstructing a bronchus, preventing inflation and drainage of lung tissue beyond the obstruction.

Since pneumonia and atelectasis are common conditions in the elderly (atelectasis frequently occurs following surgery), most pulmonary specialists will not routinely perform bronchoscopy for these conditions, but will reserve bronchoscopy for those cases in which X-ray abnormalities do not resolve within the expected period of time. The authors of an editorial in the journal Chest stated in 1989 that they "avoid FFB [flexible fiberoptic bronchoscopy] for at least six to eight weeks for slowly resolving pneumonia (radiographically) in a patient who is clinically recovering." Other physicians are more aggressive in bronchoscoping patients whose chest X-rays are consistent with pneumonia or atelectasis, out of fear of missing a diagnosis of cancer. However, low thresholds for invasive procedures in patients with pneumonia and atelectasis may contribute significantly to overutilization of bronchoscopy. More specific guidelines from the ATS regarding use of bronchoscopy in pneumonia and atelectasis would have been helpful.

Two other conditions in which more explicit guidelines would be helpful are unexplained cough and hemoptysis. A chronic cough is an annoying and potentially worrisome symptom. However, the coughing reflex can be stimulated by a number of conditions besides cancer, including: allergic rhinitis ("hay fever") with postnasal drip; asthma; heart failure; and irritation from cigarette smoke. In one study (Poe et al.) of 51 patients with chronic persistent cough and a normal chest X-ray, only one patient was found to have cancer on bronchoscopy. These authors concluded that "bronchoscopy is of limited value in determining the cause of isolated chronic cough." Another condition in which the use of bronchoscopy is controversial is in the evaluation of hemoptysis. The severity of hemoptysis ranges from coughing up small amounts of blood-tinged mucous to large amounts of frank blood. Common causes of hemoptysis include bronchitis and lung cancer. However, the incidence of lung cancer in patients with normal chest-rays is reported by some studies to be less than 5 percent. The 1986 ATS guidelines on bronchoscopy do state that "bronchoscopy is not a routine initial procedure in the evaluation of unexplained cough," but provide no further clarification of the role of the procedure in evaluating unexplained cough or

hemoptysis. When patients are referred by primary care physicians for these symptoms, pulmonary specialists may feel pressured to perform bronchoscopy as a definitive diagnostic procedure to avoid loss of referrals, even if other evidence (e.g., medical history and chest X-ray) make serious disease such as cancer unlikely.

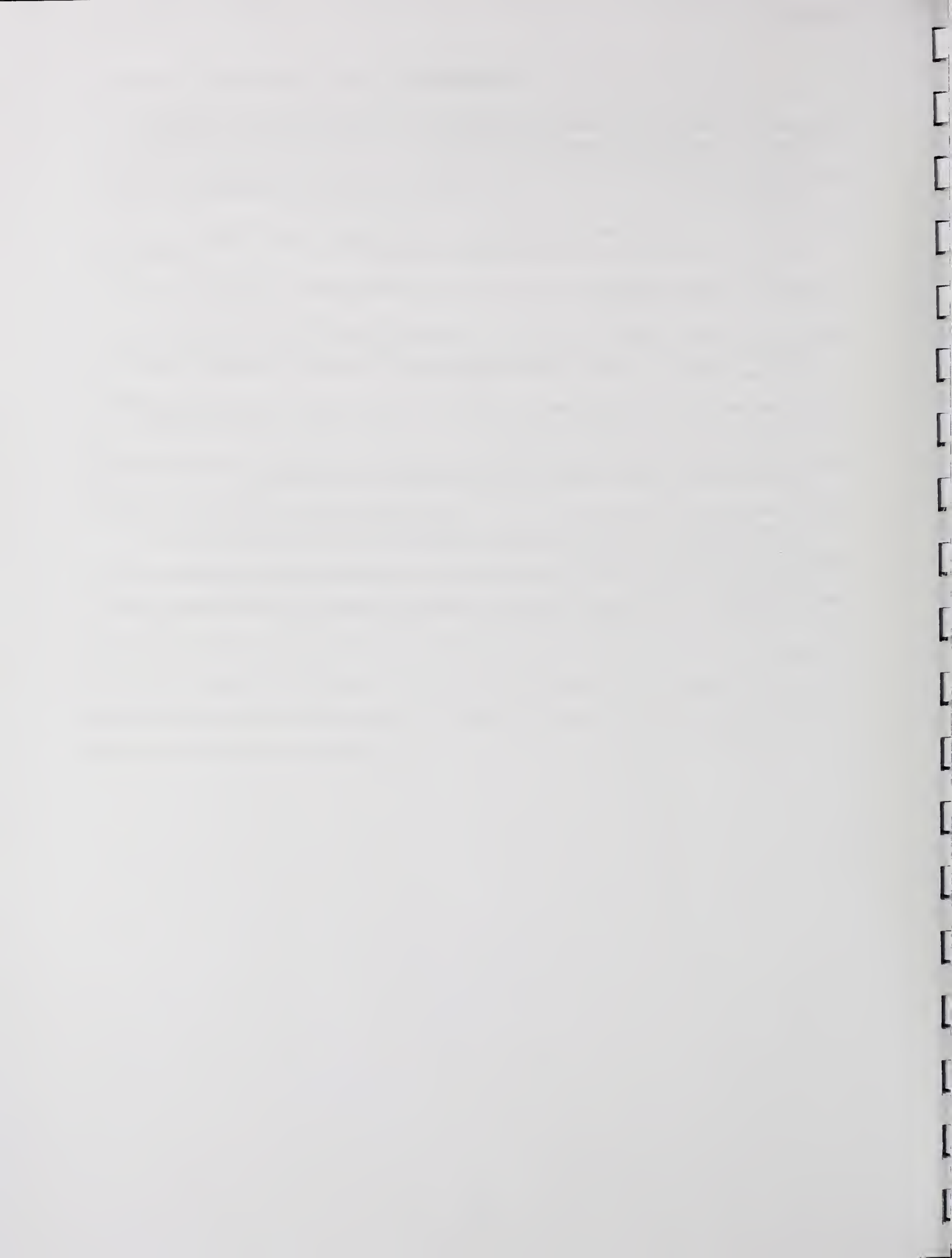
3.8 Summary

Although it has some limited therapeutic applications, bronchoscopy is used primarily to diagnose inflammatory, infectious, and malignant diseases of the bronchial tree and lung. Utilization of diagnostic bronchoscopy undoubtedly increased following the development of smaller-diameter scopes which could reach more peripheral lesions. Increased use of immunosuppressive therapy for organ transplantation has also increased the number of patients in whom bronchoscopy is indicated.

It is likely that the effects of technology changes on utilization of bronchoscopy are equalled or exceeded by the impact of changes in physician practice patterns, particularly regarding use of bronchoscopy in uncomplicated pneumonia and atelectasis. However, no broad-based studies of the appropriateness of bronchoscopy in the United States have been published, and estimates of overutilization or underutilization are not available. Guidelines published by the American Thoracic Society in 1986 are unlikely to have had a significant effect on curbing possible overutilization.

REFERENCES

- American Thoracic Society. Guidelines for fiberoptic bronchoscopy in adults. American Review of Respiratory Disease 136:1066 (1987).
- Colt HG, Morris JF. Fiberoptic bronchoscopy without premedication. Chest 98(6):1327-1330 (December 1990).
- De Fenoyl O, Capron F, Leveau B, Rochemaure J. Transbronchial biopsy without fluoroscopy: a five year experience in outpatients. Thorax 44:956-959.
- Dellinger RP. Fiberoptic bronchoscopy in adult airway management. Critical Care Medicine 18(8):882-887 (August 1990).
- Irwin RS, Corrao WM, Pratter MR. Chronic persistent cough in the adult: the spectrum and frequency of causes and successful outcome of specific therapy. American Review of Respiratory Disease 123(4 Pt. 1):413-7 (April 1981).
- O'Neil KM, Lazarus AA. Hemoptysis: indications for bronchoscopy. Archives of Internal Medicine 151:171-174 (January 1991).
- Pass HI, Delaney T, Smith PD, Bonner R, Russo A. Bronchoscopic phototherapy at comparable dose rates: early results. Annals of Thoracic Surgery 47:603-699 (1989).
- Poe RH, Israel RH, Utell MJ, Hall WJ. Chronic cough: bronchoscopy or pulmonary function testing? American Review of Respiratory Disease 126(1):162-2 (July 1982).
- Rohwedder JJ. Enticements for fruitless bronchoscopy. Chest 96(4):708-710 (October 1989).
- Sen RP, Walsh TE. Bronchoscopy: enough or too much? Chest 96(4):710-712 (October 1989).



4.0 CARPAL TUNNEL RELEASE

4.1 Relevant Anatomy and Pathology

The *median nerve* begins at the shoulder and travels down the arm and wrist to the base of the thumb, where it enters the hand. It is both a sensory nerve and a motor nerve. As a sensory nerve, it carries information to the brain from the thumb, index finger, middle finger, and half of the ring finger. As a motor nerve, it provides stimulation to muscles which flex the fingers and rotate the thumb and wrist.

As the median nerve crosses from the wrist into the hand, it passes through the *carpal tunnel*, a canal formed by the *carpal bones* (small bones in the back of the hand) and the *transverse carpal ligament* (the very hard structure at the base of the palm, just above the wrist). The median nerve may become compressed or entrapped as it passes through the carpal tunnel. Causes of such median nerve entrapment include: conditions which cause a decrease in the size of the carpal tunnel (e.g., rheumatoid arthritis affecting the wrist; immobilization of the wrist in a flexed position during treatment for wrist fracture); enlargement of the median nerve (from systemic diseases such as diabetes or hypothyroidism, or from abnormal growth of nerve tissue); and other conditions which increase pressure on the median nerve in the carpal tunnel (e.g., inflammation of tendons; crystalline deposits from gout; fluid retention in pregnancy). Probably the most common causes of median nerve entrapment, however, are occupational or avocational activities involving frequent pressure on the base of the palm (lifting weights, using screwdrivers and other hand tools), or repetitive movements of the wrist and fingers (typing, knitting, crocheting, playing musical instruments). The condition may be unilateral (typically affecting the dominant hand in occupationally-related cases) or bilateral (more likely to occur with systemic conditions such as rheumatoid arthritis, diabetes, hypothyroidism, and pregnancy).

When median nerve entrapment becomes symptomatic, it is called *carpal tunnel syndrome*. The syndrome is very common, occurring usually after age 30 and more frequently in women than in men. The first symptoms are related to the sensory function of the median nerve. These typically include numbness and tingling in the fingertips, occurring at night and

sometimes interfering with sleep. As symptoms progress, numbness and tingling become more frequent, and the patient may experience burning pain in the fingers and hand, extending sometimes down the forearm. The patient may also have symptoms related to the motor function of the median nerve, and notice a weakened grip or clumsiness in performing tasks with the fingers such as unscrewing bottle caps. Symptoms related to mild or moderate carpal tunnel syndrome are reversible if treatment is obtained in a timely manner. In advanced cases, however, irreversible damage to the motor and sensory portions of the median nerve may occur.

On physical examination, patients with carpal tunnel syndrome usually have decreased sensation to pinprick over the first three fingers and show some weakness in certain movements of the thumb. The prominent muscle in the palm, at the base of the thumb, may be noticeably shrunk (*thenar wasting*); such wasting is evidence of more advanced median nerve compression. The diagnosis of carpal tunnel syndrome may be confirmed by nerve conduction studies, which can detect abnormal slowing of sensory and motor impulses in the fingers and hand. (Pressure within the carpal tunnel may be measured directly by inserting a special catheter into the wrist and advancing it into the carpal tunnel; however, this technique is used far more in research than in clinical practice.) X-rays of the wrist may also be obtained to rule out arthritic changes or abnormal masses, and appropriate blood tests will be obtained if systemic disease is suspected.

4.2 Indications for Carpal Tunnel Release

Treatment for carpal tunnel syndrome depends upon the severity of symptoms and objective evidence of median nerve compression. For mild cases, conservative treatment is often prescribed. This includes cessation of activities which may increase pressure within the carpal tunnel (such as typing, working with hand tools, and so forth), and use of an immobilizing wrist splint while at rest and at night, to maintain the wrist in a neutral position and relieve pressure within the tunnel. Many patients with mild symptoms will obtain complete relief from these conservative measures. Oral anti-inflammatory drugs or injection of corticosteroids into the carpal tunnel may also be tried.

For patients with advanced symptoms or with thenar wasting, and for patients who have not been helped by conservative measures, surgery is indicated.

4.3 Description of Procedure

Carpal tunnel release may be performed by any surgeon who specializes in hand surgery. Such surgeons are usually orthopedic specialists, neurosurgeons, or plastic surgeons. A midline incision is made from the wrist to the middle of the palm, exposing the transverse carpal ligament. A small section of this ligament is cut to reveal the median nerve within the carpal tunnel. After the median nerve has been identified and tagged to prevent inadvertent injury, the transverse carpal ligament is cut completely in two, releasing pressure in the carpal tunnel. This, in essence, is a carpal tunnel release. (The transverse carpal ligament has little anatomic function other than to protect the carpal tunnel. When it is cut in two, a gap of only one to two centimeters is created, and this gap eventually is closed by fibrous bands.)

For patients with severe or long-standing carpal tunnel syndrome, an additional procedure called *neurolysis* may be performed. After the transverse carpal ligament is cut, the median nerve may be dissected away from surrounding tissues (such as fibrous bands or adhesions) to further reduce nerve compression. The benefits of neurolysis have been disputed, however.

When carpal tunnel syndrome is related to rheumatoid arthritis, an additional procedure is often performed with carpal tunnel release. One of the principal pathological processes in rheumatoid arthritis is an inflammatory reaction in the membrane (*synovium*) which surrounds the tendons which flex the fingers. The synovium becomes thickened and irregular. When rheumatoid arthritis affects the wrist, this synovial thickening around the flexor tendons at the wrist can impinge on the carpal tunnel, causing median nerve entrapment. In such cases, a *tenosynovectomy* is performed to remove the diseased flexor tendon synovium and prevent recurrence of carpal tunnel syndrome.

Carpal tunnel release is usually performed as an ambulatory procedure under local or regional anesthesia. Patients at increased surgical risk and patients undergoing bilateral release may require admission. Following surgery, the hand and wrist are bandaged, and the

patient wears a splint for three weeks to maintain the wrist in a neutral position. Most patients achieve good relief of symptoms following surgery, and can return to their former level of activity (including repetitive hand and wrist motions) within two to three months.

Complications of carpal tunnel release include severance of branches of the median nerve, cosmetically unacceptable scars on the wrist and palm, and formation of adhesions between tendons in the hand. These complications can usually be avoided by good surgical technique.

4.4 Changes in Technology Affecting Risk/Benefit Ratio

Carpal tunnel release was a technologically stable procedure throughout most of the 1980s. However, in the late 1980s, an endoscopic technique of carpal tunnel release was developed in Japan. An endoscope is inserted through the skin near the wrist, and advanced to a position below the transverse carpal ligament. The ligament is then cut endoscopically. Unlike the wrist-to-palm incision used in the standard procedure, endoscopic release leaves a much smaller surgical wound and scar, reducing recuperation time, and making it easier for patients to care for themselves postoperatively since no bulky dressing is required. Disadvantages of the procedure is that it is technically more difficult for the surgeon, requiring more skill to avoid inadvertent severing of median nerve branches. Furthermore, the endoscopic procedure cannot be used in patients with rheumatoid arthritis who require synovectomies at the time of carpal tunnel release.

Endoscopic carpal tunnel release is likely to grow in popularity in the U.S. for several reasons. Because of decreased post-surgical disability and recuperation, patients are likely to prefer the technique. Surgeons may feel compelled to learn the technique to remain competitive. Increased availability of endoscopic release may make surgery a more acceptable alternative to patients with less severe symptoms, and thus increase utilization of carpal tunnel release. However, endoscopic carpal tunnel release was being used experimentally in only a few centers in the U.S. in the late 1980s, and still has very limited use in this country. It would not have had any noticeable effect on utilization of carpal tunnel release during the 1985 to 1989 study period.

4.5 Changes in Indications for Carpal Tunnel Release

Carpal tunnel release is performed on patients with a specific and rather narrow complex of symptoms and findings on physical exam (carpal tunnel syndrome). The definition of the syndrome is stable (i.e., is not undergoing revision or expansion with changes in medical knowledge). It is possible that the threshold for considering surgery is changing, so that patients with less severe symptoms are more likely to undergo carpal tunnel release. This might happen, for example, if patients become more knowledgeable about carpal tunnel syndrome and are therefore more likely to seek medical care for minor symptoms and to request surgery. Changes in the threshold for surgery might also occur if physicians become more aggressive about surgical intervention in less severe cases, in order to avoid permanent nerve damage. However, there is no literature which documents such changes in the threshold for this procedure.

4.6 Shifts of Carpal Tunnel Release to Ambulatory Settings

Use of local or regional anesthesia in carpal tunnel release has been standard for a number of years, and most such procedures were being performed in ambulatory settings by 1985.

4.7 Development of Clinical Guidelines

The American Academy of Orthopaedic Surgeons has developed a set of "clinical policies" for six orthopedic conditions, including carpal tunnel syndrome. Since these were published for the first time in January 1990, they could not have had any effect on utilization of carpal tunnel release between 1985 and 1989. The clinical policies list diagnostic and therapeutic options, but provide little discussion of the appropriateness of these options in various clinical settings. Even had these guidelines been available earlier, it is unlikely that they would have had a large impact on utilization.

4.8 Summary

Carpal tunnel syndrome is a specific and fairly common cluster of symptoms and signs related to compression of the median nerve at the wrist. Diagnosis of the syndrome is usually made on the basis of symptoms and physical examination, but can be confirmed by nerve conduction studies and by directly measuring pressure within the carpal tunnel.

Endoscopic carpal tunnel release may become common in the U.S. within the next few years; however, its use here has been extremely limited to date. The standard carpal tunnel release procedure has been technologically stable for years, as has the risk/benefit ratio associated with the procedure. It is possible, however, that some increase in utilization might be attributable to increased patient awareness of carpal tunnel syndrome and its surgical treatment, and to a shift in physician preference to earlier surgical treatment of compression to minimize the risk of permanent nerve damage.

REFERENCES

- Gibson M. Outpatient carpal tunnel decompression without tourniquet: a simple local anaesthetic technique. Annals of the Royal College of Surgeons of England 72(6):408-409 (November 1990).
- Gelberman RH, Rydevik BL, Pess GM, Szabo RM, Lundborg G. Carpal tunnel syndrome: a scientific basis for clinical care. Orthopedic Clinics of North America 19(1):115-124 (January 1988).
- Josifek LF, Bleeker ML. Peripheral neuropathy, in Principles of Ambulatory Medicine (3rd edition), edited by LR Barker, JR Burton, and PD Zieve. Baltimore: Williams & Wilkins, 1991.
- Okutsu I, Ninomiya S, Hamanaka I, Kuroshima N, Inanami H. Measurement of pressure in the carpal canal before and after endoscopic management of carpal tunnel syndrome. The Journal of Bone and Joint Surgery 71-A(5):679-683 (June 1989).
- Orthopaedic Clinical Policies: Carpal Tunnel Syndrome. Park Ridge, Ill.: American Academy of Orthopaedic Surgeons, 1990.



5.0 CATARACT EXTRACTION

5.1 Relevant Anatomy and Pathology

The *lens* of the eye is composed of transparent fibers. New fibers are formed at the periphery of the lens, and older fibers are crowded together at the center, becoming more densely packed with age. Eventually, the lens begins to opacify, particularly at its center; these lens opacities are called *cataracts*. In this sense, cataracts are a normal part of aging, although the extent of opacification and the age at which it becomes symptomatic vary across individuals. The process is nearly always bilateral: both eyes are affected, but again often at different rates.

Lens opacities associated with aging are called *senescent* or *senile* cataracts, and constitute the vast majority of all cataracts. Opacification of the lens can also be caused by trauma to the eye, infection, microwaves and other forms of radiation, systemic illnesses such as diabetes mellitus, and drug therapy (particularly corticosteroids). *Congenital* cataracts (present at birth) are associated with genetic disorders such as Downs' syndrome, intra-uterine infections such as rubella, and other factors.

The lens is surrounded by a clear membrane called the *lens capsule* (Fig. 4-1), which holds the lens in place. Immediately anterior to the lens is the *iris*, a circular pigmented muscle which functions like the diaphragm in a camera to adjust the amount of light admitted to the eye.

Most of the globe of the eye (the *posterior segment*) is filled with a transparent jelly-like material called the *vitreous humor*. However, a small portion at the front of the eye (the *anterior segment*) contains a clear liquid called the *aqueous*. The iris divides this anterior segment of the eye into two parts. The *anterior chamber* is the space between the cornea and the iris. The *posterior chamber* is the space between the iris and the posterior capsule of the lens.

5.2 Indications for Cataract Surgery

Nearly everyone over the age of 60 has some opacification of the lens. However, not all cataracts impair vision; those that do are called symptomatic cataracts. By age 75, over half

the population will have diminished visual acuity attributable to cataracts. The first symptom is usually difficulty seeing clearly in bright light because of glare. Objects may seem to have halos, since the central lens opacity causes light to diffuse. Vision is better in dim light or at night: under these conditions, the iris is open wider, exposing more of the peripheral (and less opacified) lens. With a far advanced cataract (i.e., nearly totally opacified lens), the affected eye is functionally blind.

Cataracts do not need to be removed unless they significantly impair vision. When this occurs, however, the only treatment is surgery to remove the opacified lens. Cataracts are progressive and do not respond to medications. Since lens opacities are present in most individuals by age 60, but not all are symptomatic, cataract surgery is indicated only when:

- significant visual symptoms or impairment of visual acuity has been documented, and
- it is apparent that the visual symptoms or loss of acuity is caused by cataract, rather than by poor refraction, retinal disease, or other problems.

5.3 Description of Procedure

Cataract surgery is nearly always performed under local anesthesia with intravenous sedation and analgesia. Local anesthetic agents are injected around and behind the eye, paralyzing the eye and eyelid, and eliminating sensation in the area. The patient remains awake throughout the procedure. Because of its greater risks, general anesthesia is reserved for children with congenital cataracts and for extremely anxious patients.

Several methods have been developed to remove the lens from the eye. The most widely used technique until the 1980s was *intra-capsular cataract extraction* (ICCE). In this method, the lens is removed along with its capsule. First, a long incision is made at the edge of the cornea. The cornea is lifted, exposing the iris and the lens behind it. The lens and its capsule are removed using forceps, suction, or other devices. After an ICCE, the iris is the only structure remaining in the anterior segment of the eye that is capable of supporting an implanted artificial lens.

In the 1980s, *extra-capsular cataract extraction* (ECCE) began to replace intra-capsular extraction (ICCE) in the United States. With extra-capsular extraction, the cornea is lifted to

expose the iris and lens, but instead of removing the entire lens capsule, only the anterior capsule (the membrane covering the anterior surface of the lens) is excised. The lens itself is then removed, leaving the posterior capsule in place. After an ECCE, an artificial intra-ocular lens can be positioned between two stabilizing structures: the iris and the posterior capsule of the surgically-removed lens.

Other methods for cataract extraction have been developed. In *phacoemulsification*, the anterior capsule is removed and the lens is fragmented by ultrasound. The fragments are then aspirated, leaving the posterior capsule in place (as with ECCE). However, phacoemulsification is often unsatisfactory in elderly patients, whose lenses are denser and do not emulsify easily with ultrasound. The high cost of phacoemulsification equipment has also limited diffusion of the technique.

There are many potential complications of cataract extraction, including inflammation, infection, hemorrhage, retinal detachment, and glaucoma. Inflammation and retinal detachment may be more common with intra-capsular extraction. When the posterior capsule of the lens is removed, it exerts traction on the vitreous humor. Inflammation can result if bits of the vitreous are pulled into the anterior segment of the eye. Since the vitreous is also attached to the retina, changes in the vitreous that occur during or after ICCE can also cause the retina to detach from the posterior wall of the eye.

However, ECCE is associated with a problem never seen following ICCE. The posterior lens capsule (which is not removed during ECCE) often becomes cloudy and interferes with vision. In such cases, the posterior capsule is referred to as a *secondary*, *membranous*, or *after cataract*. Such cataracts occur in perhaps 40 percent of patients within two years of cataract extraction. These opacified lens capsules can be treated by again opening the eye at the cornea, removing any artificial intra-ocular lens, and cutting the posterior capsule (a procedure known as *discission of secondary membranous cataract* in CPT-4 terminology). However, a newer technique uses a neodymium-YAG (yttrium-aluminum-garnet) laser to rupture the opacified posterior capsule without opening the eye at all. Laser treatment of secondary cataracts is an office procedure, and can be performed with intra-ocular lenses in place. YAG laser treatment has become the preferred therapy for secondary membranous cataracts, which are increasing in incidence because of the growing use of extra-capsular cataract extraction.

5.4 Changes in Technology Affecting Risk/Benefit Ratio

The diffusion of the operating microscope and microsurgical techniques in the late 1970s and early 1980s made cataract surgery safer and more dependable. Before this time, ophthalmologists relied on loupes (magnifying glasses mounted on a headband or eyeglass frames) during cataract surgery. The operating microscope allows for more precise control of incisions and other surgical maneuvers, and permits the surgeon to place extremely fine sutures with great accuracy. Surgical wounds became substantially smaller, lowering the risk of infection and other surgical complications, and eliminating the need for total immobilization of the patient following cataract surgery. Diffusion of microsurgical techniques was probably nearly complete by 1985.

The most important technological changes affecting utilization of cataract surgery were improvements in artificial intra-ocular lenses (IOLs) that began about 1975 and are continuing today. Following cataract surgery, uncorrected vision is very poor, since there is no longer a lens to focus light upon the retina. Before the widespread availability of intra-ocular lenses, vision in the post-cataract patient could be corrected using either glasses or contact lenses (applied externally to the cornea). Contact lenses require considerable manual dexterity to insert and remove, and are very difficult to use for most elderly post-cataract patients. Thick spectacles, the alternative to contact lenses, were easier for patients to find and put on. However, these glasses magnify images by up to 30 percent, distort peripheral vision, and alter spatial perception. Since patients cannot resolve the distorted vision from one eye with the perspective of a normal eye, such glasses are suitable only for those who have had cataract extractions in both eyes. Even so, many patients with bilateral cataract extractions are unsatisfied with the distorted vision provided by these glasses. Problems with existing methods of visual correction limited the benefits of cataract extraction for patients with mild or moderately symptomatic cataracts: surgery could mean trading one form of visual impairment for another.

Intra-ocular lenses are implanted permanently in the eye, in either the anterior or the posterior chamber (that is, in front of or behind the iris). They may be implanted immediately following cataract extraction or at any time thereafter. Intra-ocular lenses were first implanted in humans in 1949. Early lenses frequently caused complications such as inflammation of the eye and glaucoma, and often needed to be removed. When placed in the anterior chamber, between the iris and the cornea, the artificial lens frequently caused mechanical abrasion of the cornea. When placed in the posterior chamber, between the iris and the posterior capsule, the heavy lenses often became dislocated. In the 1950s, newer lenses were developed which clipped onto the iris itself. However, these lenses also caused inflammation and glaucoma, and in addition caused shrinking or wasting of the iris. Because of various technical problems involving both surgical techniques and the design and manufacture of the lenses, IOLs were considered experimental and were not widely used throughout the 1950s and 1960s.

Since 1975, great improvements have been made in the design and manufacture of intra-ocular lenses and in the techniques by which they are implanted in the eye. In place of the anterior chamber and iris-fixated lenses used previously, nearly all modern IOLs are inserted into the posterior chamber, where they are supported by the posterior capsule. Inflammation, glaucoma, and other complications are less likely when the posterior capsule is left intact and used to support the IOL, largely because the vitreous humor is not disturbed and because mechanical irritation between the IOL and the iris or cornea does not occur. Posterior-chamber IOLs require the use of extra-capsular cataract extractions, accounting for the rapid shift to this form of cataract surgery. Use of the operating microscope and microsurgical techniques allow surgeons to completely remove remnants of lens tissue from the posterior capsule; such remnants were often responsible for inflammatory reactions when extra-capsular extraction was performed before development of the operating microscope. These microsurgical innovations have also improved surgeons' ability to position and support IOLs properly within the posterior chamber. Furthermore, ultrasound techniques allow precise intra-ocular measurements and estimation of the optical strength required of each IOL before it is implanted. Lastly, manufacturing processes have been improved to produce

more highly polished IOLs with less residue from polishing agents and sterilizing solutions and gases. These cleaner, smoother lenses are less likely to cause irritation and inflammation.

The result of all of these changes in intra-ocular lens technology was to increase the benefits of cataract extraction for patients with moderate or even mild visual symptoms, since the newer IOLs provided nearly normal vision with little inconvenience and a very low incidence of complications. Today, the vast majority of patients undergoing cataract extraction receive IOLs during the same operating room session. Although improvements in IOL technology are continuing (such as the development of soft IOLs, which can be rolled tightly and implanted through a much smaller incision), most of the technical improvements described above took place between the mid-1970s and mid-1980s. A very noticeable result of these improvements was a substantial increase in the utilization of cataract surgery throughout the 1980s.

5.5 Changes in Indications for Cataract Extraction

The general indications for cataract extraction have not changed: visual symptoms or loss of visual acuity must be documented; and the symptoms or decreased vision must be attributable to cataracts. However, the threshold for performing surgery has decreased markedly as a result of improvements in surgical techniques and especially in IOL technology. Surgery is now considered for patients with vision better than 20/40 in the affected eye, if their subjective complaints of symptoms (such as disabling glare in bright light) can be documented.

It should also be noted that the number of persons requiring cataract surgery is increasing as the population ages. However, the effect of population aging on utilization of cataract surgery will be small over the span of a few years; most of the increase in utilization is attributable to improvements in technology which have altered the risk/benefit ratio of the procedure, and made it a satisfactory form of treatment for a larger pool of individuals.

5.6 Shifts of Cataract Surgery to Ambulatory Settings

The development of microsurgical techniques in the late 1970s markedly reduced the size of surgical wounds from cataract extraction, and thus lowered the risk of wound complications (such as infection and leakage of fluid from the eye). It was no longer necessary to completely immobilize the patient or to apply constant pressure to the surgical wound. Diffusion of microsurgical techniques in the late 1970s and early 1980s made it possible to perform cataract surgery routinely as an ambulatory procedure. However, HCFA policy mandates in the early 1980s required nearly all cataract procedures to be performed in ambulatory settings.

5.7 Development of Clinical Guidelines

In 1989, the American Academy of Ophthalmology (AAO) published its first set of guidelines on cataract surgery, called Cataract in the Otherwise Healthy Adult Eye. The guidelines acknowledge the impact of changes in surgical techniques and IOL technology on cataract surgery utilization, and state that "extracapsular cataract extraction...with implantation of a posterior chamber IOL is the current procedure of choice in the vast majority of operations for removing uncomplicated cataracts."

The guidelines discuss indications for cataract surgery in only broad terms. According to the AAO, cataract surgery is indicated if "the best correctable visual acuity in the affected eye is 20/50 or worse" and if "the eye examination confirms that cataract is the limiting factor for improving visual function." However, even when vision in the affected eye is 20/40 or better, surgery may be indicated if warranted by the patient's subjective complaints (such as disabling glare, or problems with daily activities such as driving, reading, or watching TV). Such guidelines provide a great deal of latitude for physicians and patients in deciding whether cataract surgery should be done, and make it difficult to judge when surgery is used inappropriately.

Implicitly, however, the guidelines recognize by these general statements that no good objective criteria exist for determining when cataracts require surgery. Results of the Snellen

visual acuity test (in which normal vision is 20/20) are highly dependent on the lighting levels under which the test is performed. Patients with cataracts may have nearly normal vision in a darkened room, but perform much worse under bright lights. They may notice their visual symptoms are more pronounced when driving towards the sun, or driving at night facing oncoming headlights. The guidelines recognize that visual acuity is not a sufficient standard for determining the appropriateness of cataract surgery, but that the true criterion is the degree of visual disability. Other objective methods of (such as glare testing) are now being explored as adjuncts to visual acuity as criteria for determining the appropriateness of cataract extraction. However, these methods have not been sufficiently standardized to be of clinical value in making decisions regarding surgery.

5.8 Summary

The rapid growth in the utilization of cataract surgery is attributable primarily to technological advances in surgical techniques and in the design and manufacture of intra-ocular lenses. The surgical procedure is safe and has reliably good outcomes, and post-cataract patients have nearly normal vision after IOL insertion. The decreased risks and increased benefits of combined cataract extraction and IOL insertion have made these procedures an acceptable treatment for a larger number of cataract patients with less severe visual symptoms.

REFERENCES

- Allarakhia L, Lindstrom RL. Soft intraocular lenses. International Ophthalmology 12:185-191 (1988).
- American College of Cardiology and American Heart Association. Guidelines for permanent cardiac pacemaker implantation. Journal of the American College of Cardiology 4(2):434-442 (August 1984).
- American College of Obstetricians and Gynecologists. Dysfunctional Uterine Bleeding. Technical Bulletin No. 134, October 1989.
- American College of Obstetricians and Gynecologists. Estrogen Replacement Therapy. Technical Bulletin No. 93, June 1986.
- American College of Physicians. Clinical competence in diagnostic esophagogastroduodenoscopy. Annals of Internal Medicine 107(6):937-939 (December 1987).
- American College of Physicians. Endoscopy in the evaluation of dyspepsia. Annals of Internal Medicine 102(2):266-269 (February 1985).
- American College of Physicians. Endoscopic sclerotherapy for esophageal varices. Annals of Internal Medicine 100(4):608-610 (April 1984).
- American Society for Gastrointestinal Endoscopy. Guidelines for establishment of gastrointestinal endoscopy areas. Gastrointestinal Endoscopy 34(3, suppl.):3S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of esophagitis. Gastrointestinal Endoscopy 34(3, suppl.):9S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of the patient with peptic ulcer disease. Gastrointestinal Endoscopy 34(3, suppl.):12S-13S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of upper gastrointestinal hemorrhage. Gastrointestinal Endoscopy 34(3, suppl.):4S-5S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the surveillance of premalignant conditions of the upper gastrointestinal tract: guidelines for clinical application. Gastrointestinal Endoscopy 34(3, suppl.):18S-20S (1988).
- American Society for Gastrointestinal Endoscopy. Standards of practice of gastrointestinal endoscopy. Gastrointestinal Endoscopy 34(3, suppl.):8S (1988).
- American Society for Gastrointestinal Endoscopy. Statement on role of short courses in endoscopic training. Gastrointestinal Endoscopy 34(3, suppl.):14S-15S (1988).
- American Thoracic Society. Guidelines for fiberoptic bronchoscopy in adults. American Review of Respiratory Disease 136:1066 (1987).
- Apple DJ, Mamalis N, Loftfield K, Googe JM, Novak LC, Kavka-Van Norman D, Brady SE, Olson RJ. Complications of intraocular lenses: a historical and histopathological review. Survey of Ophthalmology 29(1):1-54 (July-August 1984).
- Boyd ME. Dilatation and curettage. Canadian Journal of Surgery 32(1):9-13 (January 1989).

REFERENCES (continued)

- Brooks PG, Serden SP. Hysteroscopic findings after unsuccessful dilatation and curettage for abnormal uterine bleeding. American Journal of Obstetrics and Gynecology 158(6, Pt. 1):1354-1357 (June 1988).
- Brook RH, Park RE, Chassin MR, Solomon DH, Keesey J, Kosekoff J. Predicting the appropriate use of carotid endarterectomy, upper gastrointestinal endoscopy, and coronary angiography. New England Journal of Medicine 323(17):1173-1177 (October 25, 1990).
- Chua KL. Recent advances in upper gastrointestinal endoscopy. Annals of the Academy of Medicine of Singapore 12(4):535-538 (October 1983).
- Coleman WH. Gastrosocopy: a primary diagnostic procedure. Primary Care 15(1):1-11 (March 1988).
- Colt HG, Morris JF. Fiberoptic bronchoscopy without premedication. Chest 98(6):1327-1330 (December 1990).
- Das G, Carlblom D. Artificial cardiac pacemakers. International Journal of Clinical Pharmacology and Therapeutic Toxicology, 28(5):177-189 (May 1990).
- De Fenoyl O, Capron F, Leveau B, Rochemaure J. Transbronchial biopsy without fluoroscopy: a five year experience in outpatients. Thorax 44:956-959.
- Dellinger RP. Fiberoptic bronchoscopy in adult airway management. Critical Care Medicine 18(8):882-887 (August 1990).
- Denditt DG, Milstein S, Buetikofer J, Gornick CC, Mianulli M, Fetter J. Sensor-triggered, rate-variable cardiac pacing. Annals of Internal Medicine 107(5):714-724 (November 1987).
- Gerretsen G, te Velde J. A new method for diagnostic curettage. European Journal of Obstetrics, Gynecology, and Reproductive Biology 25(3):239-242 (July 1987).
- Goldfarb HA. D & C results improved by hysteroscopy. New Jersey Medicine 86(4):277-279 (April 1989).
- Hemlmerhorst TJM, Franke HR, Risse EKJ, Heeregrave-Bechthold M, Kenemans P, Stolk JG. Endocervical curettage by Vabra aspiration as part of colposcopic evaluation. Gynecologic Oncology 36:312-316 (1990).
- Irwin RS, Corrao WM, Pratter MR. Chronic persistent cough in the adult: the spectrum and frequency of causes and successful outcome of specific therapy. American Review of Respiratory Disease 123(4 Pt. 1):413-7 (April 1981).
- Koonings PP, Grimes DA. Endometrial sampling techniques for the office. American Family Physician 40(4):207-210 (October 1989).
- Kowey PR, Mullan DF, Wetstein L. Pacemaker therapy. Surgical Clinics of North America 65(3):595-611 (June 1985).
- Liesegang TJ. Cataracts and cataract operations (second of two parts). Mayo Clinic Proceedings 59:622-632 (September 1984).
- Ludmer PL, Goldschlager N. Cardiac pacing in the 1980s. New England Journal of Medicine 311(26):1671-1680 (December 27, 1984).
- O'Neil KM, Lazarus AA. Hemoptysis: indications for bronchoscopy. Archives of Internal Medicine 151:171-174 (January 1991).

REFERENCES (continued)

Ophthalmic Procedures Assessment: Cataract Surgery in the 1980s. San Francisco: American Academy of Ophthalmology, 1989.

Ophthalmic Procedures Assessment: Nd:YAG Photodisruptors. San Francisco: American Academy of Ophthalmology, 1989.

Pass HI, Delaney T, Smith PD, Bonner R, Russo A. Bronchoscopic phototherapy at comparable dose rates: early results. Annals of Thoracic Surgery 47:603-699 (1989).

Poe RH, Israel RH, Utell MJ, Hall WJ. Chronic cough: bronchoscopy or pulmonary function testing? American Review of Respiratory Disease 126(1):162-2 (July 1982).

Preferred Practice Pattern: Cataract in the Otherwise Healthy Adult Eye. San Francisco: American Academy of Ophthalmology, 1989.

Rohwedder JJ. Enticements for fruitless bronchoscopy. Chest 96(4):708-710 (October 1989).

Schachat, AP. Common problems associated with impaired vision: cataracts and age-related macular degeneration, in Principles of Ambulatory Medicine (3rd edition), edited by LR Barker, JR Burton, and PD Zieve. Baltimore: Williams & Wilkins, 1991.

Sen RP, Walsh TE. Bronchoscopy: enough or too much? Chest 96(4):710-712 Van Steigman G. Endoscopic ligation of esophageal varices. American Journal of Surgery 156(2):9B-12B (September 1988).

Spiritos NM, Schlaerth JB, D'Ablaing G, Morrow CP. A critical evaluation of the endocervical curettage. Obstetrics & Gynecology 70(5):729-733 (November 1987).



6.0 CORONARY ARTERY BYPASS GRAFT SURGERY

6.1 Overview

The treatment of coronary artery disease has undergone a dramatic evolution during the past 20 years. The first major advance was the development of coronary artery bypass graft (CABG) surgery in the late 1960s. CABG surgery became the mainstay of treatment for severe symptomatic coronary artery disease during the 1970s and into the 1980s when the introduction of balloon dilatation of coronary artery obstruction by percutaneous transluminal coronary angioplasty (PTCA) offered a viable alternative in selected patients. Present and projected future utilization patterns reflect both the unique contributions of each of these technologies and the competition between them. Improvements in medications to treat angina pectoris, dissolve or prevent blood clots in coronary arteries, and to slow the progression of coronary artery disease have further altered indications for invasive treatments and improved overall prognosis.

6.2 Relevant Anatomy and Pathology

The heart is a muscular pump that is remarkably well designed to supply the demands of other organs for oxygen and other blood-carried nutrients by altering its output in response to the highly variable demands imposed by physical exertion and other environmental factors. To meet these demands, the heart muscle, in turn, requires its own blood supply which is delivered in large measure through a branching system of coronary arteries.

A brief description of the anatomy of the coronary arteries will help the reader to interpret indications for CABG that are based on the number, locations, and severity of coronary artery obstructions as well as symptoms. There are two main coronary arteries, the left main coronary artery (LMCA) which supplies blood to the left ventricular muscle and the right coronary artery (RCA) which supplies the right ventricular muscle. Each main artery divides into a number of branches and, in fact, the left and right coronary artery systems usually connect with each other in their *distal* branches (those furthest from the origin). The

left coronary artery is in many ways the more critical because of the greater muscle mass of the left ventricle required to pump blood into the higher pressure systemic circuit that supplies most of the body. The right ventricle pumps into the lower pressure pulmonary artery circuit. The left main coronary artery (LMCA) branches into two major divisions, the left anterior descending (LAD) and the left circumflex (CX) artery each of which has a variety of *proximal* (those closest to the origin) and distal branches. Coronary artery disease may lead to narrowing or complete occlusion of any one or more of the main coronary arteries or their branches.

The number, locations, anatomical characteristics, and severity of coronary artery stenoses have important implications for the choice of CABG, PTCA, or medical treatment and for short- and longer-term prognosis. Critical coronary artery disease is traditionally classified as left main, one, two, or three vessel disease based on the presence of 70 percent or more reduction in the diameter of the LMCA or one or more of the RCA, LAD, and CX. Because of the extraordinary risk associated with occlusion of the LMCA, 50 percent obstruction is often accepted as evidence of "critical stenosis" for this vessel. The type and location of obstruction in any given coronary artery are also important considerations. Proximal and localized obstruction are well suited for either PTCA or CABG, while distal or diffuse obstruction are generally better treated by CABG.

6.3 Indications for CABG Surgery

Most candidates for CABG either have symptoms of angina pectoris which cannot be adequately controlled with medications or have had a myocardial infarction with residual patterns of myocardial ischemia that indicate they are at high risk of future infarctions. Less commonly, syncope or cardiac arrest may be the presenting symptom, and, occasionally, a coronary angiogram done in an asymptomatic patient will identify LMCA or extensive three vessel disease that suggests the need for CABG even in the absence of symptoms.

The treatment decision takes into account the type and severity of symptoms, anatomical findings on coronary angiography, and factors affecting the risk of the procedure such as the presence of left ventricular failure or significant comorbidities. The resulting

benefit and risk assessments are complex ones. Available evidence indicates that CABG may extend life in patients with LMCA or three vessel disease and, possibly, in two vessel disease if the LAD artery is involved. Otherwise, the benefit from either CABG or PTCA is usually measured only in terms of improved quality of life due to better relief of symptoms than can be achieved with medical therapy alone.

6.4 Description of Procedure

A CABG operation is an open heart procedure performed using a cardiopulmonary bypass machine. After the chest has been opened, the heart is isolated and the cardiopulmonary bypass machine is connected in a fashion that permits it to perform the functions of the heart and lungs while the coronary artery occlusions are being bypassed. The advantages of this technique are that the heart can be stopped and cooled during the procedure. Respectively, these steps permit the surgeon to have a still heart to operate on and protect the heart muscle from metabolic damage.

Bypasses of coronary artery occlusions are performed using either saphenous vein grafts obtained from the legs, internal mammary (internal thoracic) arteries obtained from the undersurface of the chest wall, or gastroepiploic arteries obtained from the region of the stomach. Venous grafts have the advantages of being more adaptable to being inserted wherever needed. Arterial grafts, while less mobile, have the distinct advantage of exhibiting better long-term graft patency. In either case, the vessels are small and microsurgical techniques are required to join the grafts to coronary arteries.

Other procedures that may be performed during a CABG operation include *left ventricular aneurysmectomy* (excision of a non-functional region of myocardium), *coronary* or *carotid endarterectomy*, or *intraoperative coronary angioplasty*.

Complications

Complications of CABG surgery can be broadly divided into those occurring in the intraoperative and post-operative periods. Intraoperative complications include adverse reactions to anesthetic agents, technical surgical problems, and complications related to the

cardiopulmonary bypass machine. A particularly critical time is when the operation has been completed and attempts are made to restart the heart and "wean" the patient off cardiopulmonary bypass. Problems are especially likely to be encountered in patients with pre-operative heart failure. In such cases, the first steps are to ensure that blood volume has been fully restored and to stimulate the heart muscle with medications. If these measures fail, an *intraaortic balloon pump* or *ventricular assist device* may be inserted to substitute for heart function and tide the patient over until the heart recovers sufficiently to function on its own. Post-operative complications increase the risk of operative mortality and also increase short- and long-term morbidity. The more common of these are bypass occlusion or bleeding that may require reoperation, myocardial infarction, stroke, acute renal failure, pneumonia, and stroke.

6.5 Changes In Technology Affecting the Risk/Benefit Ratio

Major technical advances in CABG surgery techniques took place during the late 1970s and early 1980s that markedly reduced operative mortality and improved outcomes. The more important of these developments were the introduction of *cold cardioplegia* (techniques for cooling and stopping the heart), increased use of the internal mammary artery as a bypass conduit, and the ability to achieve more complete revascularization by inserting greater numbers of bypass grafts. Cold cardioplegia, by reducing the metabolism and oxygen demand of the heart muscle, has reduced the frequency of perioperative myocardial infarction, permitted longer operating times, and reduced operative mortality. Internal mammary artery grafts have been associated with increased graft patency, compared to saphenous vein grafts, and improved long-term survival. Routine use of *antiplatelet therapy* (to reduce the tendency of the blood to clot) has also contributed to improved graft patency. Since the mid-1980s, however, CABG technology has been relatively stable.

6.6 Changes in Indications for CABG Surgery

Changes in indications for CABG surgery, and associated changes in utilization rates, have been affected by at least four factors: (1) increased propensity to operate on older and

sicker patients; (2) increasing numbers of reoperations in patients who have undergone previous CABG surgery; (3) competition engendered by technological advances and widespread acceptance of PTCA; and (4) studies that have raised questions about the appropriateness of CABG applications.

There is no question that "safer and better" CABG surgery was responsible for broadening clinical indications and the steady growth of CABG utilization during the mid-1980s especially among older patients with more severe heart disease. Operative mortality in these populations is in the 3 to 4 percent range in all but very high risk patients. Reoperations in previous CABG recipients also represent a "new" patient pool which is both at higher risk from CABG surgery and presents unique technical challenges. Some cardiac surgery programs currently include 20 to 30 percent of "redos" in their caseloads.

Countering these stimuli to the growth of CABG surgery has been competition from PTCA. Initially targetted at discrete vascular lesions in single vessel disease, progress in PTCA technology has extended its applications to multivessel and more extensive disease. The dramatic growth of PTCA volume between 1983 and 1990 reflects, in part, substitution of PTCA in patients who previously would have received CABG surgery.

Finally, studies that have suggested relatively high rates of inappropriate CABG surgery may well be affecting selection of patients for the procedure. For example, in the mid 1980s, RAND investigators found that 14 percent of procedures performed in three hospitals in a western state were for inappropriate reasons and another 30 percent were for equivocal reasons according to criteria developed by a panel of experts.

6.7 Development of Clinical Guidelines

Concern of over inappropriate use of CABG surgery has led to the development of practice guidelines by four separate groups. In 1989, the PROs implemented pre-admission certification for CABG and other selected high volume surgical procedures based on explicit criteria. Evaluation of this initiative has suggested that it was not cost-effective, however, and it was discontinued in October, 1991. Indirect effects of raising awareness to a possible problem may have been greater than measurable effects of implementation, however.

Three sets of comprehensive practice guidelines for CABG have recently been completed. One of these developed by the American College of Cardiology and American Heart Association has been published. The other two, one by the RAND Corporation and Academic Medical Center Consortium and the other by the Health Care Financing Administration, are currently being field-tested. These practice guidelines will not have affected CABG utilization during the present study but may well affect future utilization.

6.8 Summary

CABG technology improved considerably during the 1970s and early 1980s but has been essentially stable since the mid-1980s. Utilization trends in the late 1980s reflect the complex interaction of extension of a "safer and better" procedure to "older and sicker" patients, increasing numbers of reoperations in patients with previous CABG, increasing competition from PTCA, and possible constraints imposed by concerns about the rates of inappropriate CABG surgery.

REFERENCES

- ACC/AHA Guidelines and Indications for Coronary Artery Bypass Graft Surgery. A Report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures. Journal of the American College of Cardiology 1991;17:543-589.
- Cosgrove D, Loop F, Lytle B, et al. Primary myocardial revascularization. Journal of Thoracic Cardiovasc Surgery 1984;88:673-684.
- Chavez A, Lytle B, Loop F. Elective coronary surgery. Cardiovasc Clinics 1987;17:3-15.
- Leape LL, Hilborne LH, Stason WB, et al. Coronary artery bypass graft surgery. A review of the literature regarding efficacy and risks. The RAND Corporation. Santa Monica CA. 1991.
- Winslow CM, Kosecoff JB, Chassin M, et al. The appropriateness of performing coronary artery bypass surgery. JAMA 1988;260:505-509.

7.0 DILATATION AND CURETTAGE (D & C) OF UTERUS

7.1 Relevant Anatomy and Pathology

The uterus is a hollow organ with two major layers: a muscular layer (*myometrium*) and an inner layer (*endometrium*) that lines the uterine cavity. The endometrial layer proliferates in response to estrogen, becomes "secretory" in response to progesterone, and then sloughs off when hormones are withdrawn. Such changes occur with each menstrual cycle in premenopausal women; they are also elicited to some degree by estrogen replacement therapy (which is usually given in cyclical doses and with progesterone, to mimic normal menstrual cycles and to induce monthly shedding of endometrial tissue).

Abnormal uterine bleeding has two major causes: disruption of normal hormonal balance; and abnormalities of the endometrium (such as polyps or endometrial cancer) or myometrium (benign muscle growths known as myomas or fibroid tumors).

7.2 General Indications

Dilatation and curettage of the uterus is performed as a diagnostic procedure to obtain tissue samples of the endometrium (the inner lining of the uterus) to investigate conditions such as infertility and abnormal vaginal bleeding. In some cases of abnormal vaginal bleeding, D & C may also serve a therapeutic function, by removing the tissue responsible for the abnormal bleeding. Such therapeutic effects are more frequent in premenopausal than postmenopausal women.

In the Medicare population, postmenopausal bleeding is the major indication for D & C. Postmenopausal bleeding may be caused by a number of conditions, including fibroid tumors and endometrial polyps. However, the most serious condition commonly associated with postmenopausal bleeding is endometrial cancer. Endometrial cancer is found primarily in postmenopausal women, and about 8 percent of women with postmenopausal bleeding will be found to have cancer. In order to rule out suspected endometrial cancer, one must sample the endometrial tissue as completely as possible. D & C has been the standard procedure for complete endometrial sampling. If cancer is found, standard treatment includes hysterectomy.

7.3 Description of Procedure

The vagina is prepared with antiseptic solution and the bladder is catheterized. The uterus and ovaries are examined manually by the surgeon to determine size and position, and to rule out the presence of abnormal masses.

Tissue samples are obtained first from the cervical canal. The cervix is then completely dilated, and the endometrial lining of the uterus is scraped thoroughly with a sharp instrument called a curette. Tissue obtained by scraping is sent for examination by a pathologist.

The procedure is usually performed under general anesthesia for several reasons: the procedure, especially dilatation of the cervix, is painful; also, manual examination of the uterus and ovaries is much more satisfactory when the patient's muscles are fully relaxed by general anesthesia. However, adequate pain control can be achieved using local anesthesia (paracervical block) and intravenous sedation; this may be the preferred form of anesthesia in patients with contraindications to general anesthesia, such as cardiac or pulmonary disease. Use of local anesthesia for D & C may therefore be more common among the Medicare population; nevertheless, the vast majority of D & Cs under Medicare are performed under general anesthesia.

Complications of D & C include hemorrhage, infection, perforation of the uterus and uterine adhesions (formation of scar tissue within the uterine cavity).

7.4 Changes in Technology Affecting Risk/Benefit Ratio

D & C of the uterus is a very old procedure, having been introduced in 1843. Although its use has grown steadily over the past 50 years, the procedure itself has changed very little. However, utilization of D & C may have been influenced recently by several related technologies, some of which may serve as partial substitutes and thereby decrease D & C utilization. Other recent technological changes may actually have increased the utilization of D & C.

7.4.1 Hysteroscopy

Fiberoptic hysteroscopy is the application of endoscopic technology to uterine disease. The technology has been available for two decades, but was not used widely until the mid-1980s. It is used primarily as a diagnostic tool to inspect the anatomy of the uterine cavity, especially for the presence of focal lesions such as fibroid tumors or polyps, and to obtain small tissue samples. The amount of tissue obtained with hysteroscopic biopsy, however, is limited and the procedure is therefore inadequate to rule out endometrial cancer in postmenopausal women. In this group of patients, hysteroscopy does not substitute for D & C and is more likely to be performed in addition to D & C, allowing the surgeon to search for focal lesions and still obtain an adequate sample of endometrial tissue.

More recently, it has also been used therapeutically, to remove uterine adhesions and polyps, and to reduce the size of fibroid tumors in women of child-bearing age without sacrificing all or part of the uterus. These therapeutic uses are recent, and would have had little effect on Medicare utilization in the 1985-1988 period.

To better visualize the endometrium, the uterine cavity is usually expanded or distended with gas or liquid during hysteroscopy. Since such distention is painful, hysteroscopy is usually performed under general anesthesia.

7.4.2 Endometrial Biopsy

The traditional endometrial biopsy is simply a very limited D & C: the surgeon can partially dilate the cervix and, using a curette similar to that for D & C, obtain a small sample of endometrial tissue for pathologic examination. Because the cervix is only slightly dilated, the procedure can be performed without anesthesia.

Since they reflect the diffuse cyclical effects of estrogen and progesterone, incomplete samples obtained from endometrial biopsy are often sufficient to diagnose the cause of abnormal bleeding in premenopausal women, in whom such bleeding is most frequently associated with hormonal imbalance. In older women, however, the small samples obtained

with standard biopsies are inadequate to rule out endometrial cancer and cannot be used as substitutes for D & C in the evaluation of abnormal bleeding.

Newer endometrial sampling technologies have been developed, however, in which the use of suction replaces or complements the mechanical scraping of the standard D & C. These aspiration sampling techniques use a long thin hollow tube (also called a "curette," but very different from the sharp instrument used in a D & C). Aspiration curettes may be reusable or disposable, and may be made of stainless steel or plastic. Suction may be applied by an external pump or simply by a large syringe. A number of proprietary aspiration curettes are marketed, such as Vabra, Abradul, Karman, Pipelle, Novak, and Masterson.

Since aspiration curettes are very thin, the cervix need not be dilated, and aspiration biopsy or curettage can be performed in an office setting with no anesthesia. Its diagnostic accuracy is similar to that of the D & C, with 96 percent to 98 percent accuracy in diagnosing cancer of the endometrium, according to one study. However, controlled studies comparing aspiration techniques with standard D & C are difficult to perform. (One would prefer to compare both procedures in the same subject. However, each technique can remove abnormal tissue and thus limit the diagnostic accuracy of the second procedure.) In the absence of controlled comparisons, many gynecologists rely on D & C as the standard in cases where endometrial cancer is suspected. Although aspiration curettage may be performed initially as an office procedure (because it requires no anesthesia, advanced scheduling, or patient preparation), most postmenopausal women with abnormal bleeding will still receive a standard D & C.

Aspiration sampling techniques are more likely to substitute for D & C in postmenopausal women receiving estrogen therapy. Replacement estrogen is being used increasingly to minimize osteoporosis in postmenopausal women. However, estrogen therapy increases both the risk of endometrial cancer and the incidence of postmenopausal bleeding. Women taking replacement estrogen for osteoporosis are more likely to undergo some sort of endometrial sampling procedure. If bleeding occurs, a D & C is usually performed. In the absence of bleeding, many women will be requested to undergo routine endometrial monitoring, once before beginning estrogen therapy and then perhaps yearly. For these latter

women, aspiration curettage may be a satisfactory substitute for standard D & C. Thus, although estrogen replacement therapy may have increased the need for D & C, the increase may be moderated by the substitution of aspiration sampling methods.

7.5 Shifts of Procedures to Ambulatory Settings

In the 1980s, pressure by third-party payors caused D & Cs to shift from primarily inpatient to primarily outpatient procedures. Today, the majority of D & Cs, even for Medicare patients, are performed in ambulatory surgery settings. Only those patients with increased surgical risk from comorbid conditions are likely to be admitted for D & C.

Although the majority of D & Cs are performed under general anesthesia, the procedure itself is brief and patients therefore recover quickly from the effects of anesthesia. Most patients can be discharged to home a few hours after the procedure with oral medication for pain control.

7.6 Development of Clinical Guidelines for D & C

The American College of Obstetricians and Gynecologists (ACOG) is the organization with greatest influence on physician practice in Ob-Gyn. ACOG publishes a series of "technical bulletins" covering specific conditions. However, the College states that these bulletins do "not define a standard of care." Rather, they "present recognized methods and techniques of clinical practice for consideration by obstetrician-gynecologists for incorporation into their practices."

There is no single technical bulletin that covers all aspects of the D & C procedure. Instead, D & C is discussed in several bulletins in the context of specific conditions. One bulletin relevant to the Medicare population is that published for estrogen replacement therapy in June, 1986. This bulletin states that aspiration curettage is an acceptable procedure for the routine evaluation of bleeding in women on estrogen therapy, and that D & C is necessary only when aspiration curettage is unsuccessful, or when endometrial abnormalities have been demonstrated by a previous endometrial sampling procedure. The bulletin also

advocates yearly endometrial biopsy during estrogen replacement therapy in specific circumstances.

The influence of ACOG technical bulletins on Ob-Gyn practice is difficult to evaluate. The College publishes two major Ob-Gyn journals; however, the bulletins were not routinely sent to journal subscribers until very recently, and are therefore not generally available in medical libraries.

7.7 Summary

D & C is an old and stable technology. Indications for its use in the Medicare population are also stable; however, the need for D & C in post-menopausal women is probably steadily increasing due to increased use of replacement estrogen therapy. Although hysteroscopy and aspiration sampling techniques can be substituted for D & C for many conditions, these procedures are less satisfactory substitutes in post-menopausal women because the risk of endometrial cancer requires more complete examination of endometrial tissue. D & Cs have become primarily ambulatory surgical procedures, with the changeover occurring in the mid-1980s.

REFERENCES

- American College of Obstetricians and Gynecologists. Dysfunctional Uterine Bleeding. Technical Bulletin No. 134, October 1989.
- American College of Obstetricians and Gynecologists. Estrogen Replacement Therapy. Technical Bulletin No. 93, June 1986.
- Boyd ME. Dilatation and curettage. Canadian Journal of Surgery 32(1):9-13 (January 1989).
- Brooks PG, Serden SP. Hysteroscopic findings after unsuccessful dilatation and curettage for abnormal uterine bleeding. American Journal of Obstetrics and Gynecology 158(6, Pt. 1):1354-1357 (June 1988).
- Gerretsen G, te Velde J. A new method for diagnostic curettage. European Journal of Obstetrics, Gynecology, and Reproductive Biology 25(3):239-242 (July 1987).
- Goldfarb HA. D & C results improved by hysteroscopy. New Jersey Medicine 86(4):277-279 (April 1989).
- Hemlmerhorst TJM, Franke HR, Risse EKJ, Heeregrave-Bechthold M, Kenemans P, Stolk JG. Endocervical curettage by Vabra aspiration as part of colposcopic evaluation. Gynecologic Oncology 36:312-316 (1990).
- Koonings PP, Grimes DA. Endometrial sampling techniques for the office. American Family Physician 40(4):207-210 (October 1989).
- Spiritos NM, Schlaerth JB, D'Ablaing G, Morrow CP. A critical evaluation of the endocervical curettage. Obstetrics & Gynecology 70(5):729-733 (November 1987).



8.0 TOTAL HIP REPLACEMENT (THR)

8.1 Relevant Anatomy and Pathology

Mechanically, the hip is a relatively simple ball-and-socket joint. The ball is the rounded head of the *femur*. The socket is formed by the *acetabulum*, a cup-shaped depression in the pelvic bones, and by the strong *capsule* of the hip joint, which extends from the acetabulum to completely enclose the femoral head. The capsule is strengthened by ligaments connecting the acetabulum and femur. The ball-and-socket construction permits a wide range of motion in all directions.

The opposing joint surfaces of the acetabulum and femoral head are covered with cartilage so that the surfaces glide smoothly against one another. Damage to the joint cartilage is most commonly caused by two forms of arthritis. *Osteoarthritis* (OA), also known as *degenerative joint disease* (DJD), is the most prevalent type. OA is uncommon below the age of 35, and increases in prevalence with age. Almost 70 percent of persons age 65 or over have radiologic evidence of OA, and up to 40 percent of these may have some symptoms. Its exact etiology is unknown, but a major contributing factor is excessive wear on joints (e.g., from occupational or recreational activities, obesity, or slight misalignment of bones leading to uneven wear). When exposed to excessive wear over prolonged periods, joint cartilage softens and thins, and eventually erodes completely, exposing bone at the joint surface. Usually only one or a few joints are affected. Symptoms typically include a deep ache relieved by rest, and stiffness after resting. When OA affects the hip, the patient at first notices aching in the groin, buttock, or thigh, aggravated by activities such as prolonged walking. As the disease progresses, the patient may need to use a cane or crutch to transfer weight away from the affected hip. Advanced OA of the hip can severely limit mobility, preventing the patient from climbing stairs or even from walking more than a few feet.

Rheumatoid arthritis (RA) may also affect the hip joint. RA is much less common than OA, affecting only 1 or 2 percent of the general population. Although RA may occur at nearly any age, most patients develop their first symptoms between the ages of 30 and 50. Women

are more often affected than men. Unlike OA, RA is a systemic illness, affecting many body systems in addition to the joints: patients with RA may have anemia, lung disease, skin nodules, enlargement of lymph nodes and spleen, and other problems. RA typically affects several joints at the same time, usually in a symmetrical distribution (e.g., both knees, and the wrists and fingers of both hands). RA is more likely than OA to cause bilateral hip disease. Although OA and RA differ in many respects, both forms of arthritis can lead to severe restriction of mobility when the hip joint is affected.

In addition to arthritis, the other important cause of hip disease in the elderly is fracture of the femur at or near the femoral head. Hip fractures occur more commonly in the elderly, and most commonly in elderly females, because of the higher prevalence of *osteoporosis*. Osteoporosis is a generalized decrease in bone density and strength that affects both men and women with increasing age; however, it occurs earlier and more rapidly in women, with accelerated bone loss beginning at menopause. In patients with significant osteoporosis, fractures can occur with relatively minor trauma in areas such as the vertebrae, wrist, upper arm, lower leg, and hip. Hip fractures are of particular concern in the elderly because they frequently cause a permanent decrease in mobility, even with excellent treatment and healing. Two complications of hip fracture are associated with marked reductions in function restriction of activity. First, osteoporotic bones may not heal properly following a fracture, a condition referred to as *non-union*. If proper healing does not occur, the affected leg will not be able to bear weight. Second, most of the blood supply to the femoral head passes through the *femoral neck*, an area of decreased diameter between the head and shaft of the femur. Fractures of the femoral neck may sever these fragile vessels, often resulting in death of bony tissues in the head. Death of bone following loss of blood supply (referred to as *avascular necrosis* or *osteonecrosis*) leads to severe pain with loss of hip function. Non-union and avascular necrosis are serious complications and can result in permanent loss of mobility without appropriate surgical treatment.

8.2 Indications for Total Hip Replacement

In rheumatoid arthritis, the goal of medical therapy is to control the inflammatory process which causes joint pain, joint destruction, and other symptoms. Patients are usually

treated with non-steroidal anti-inflammatory agents (aspirin, ibuprofen, indomethacin, and others), oral steroids (prednisone), or other drugs.

In osteoarthritis, therapy is directed to controlling pain with analgesics (e.g., acetaminophen) or non-steroidal anti-inflammatory agents, as well as eliminating factors which may cause unnecessary stress on the hip joint (weight reduction in obesity; proper balance of activity and rest; use of corrective shoes or a cane for walking, if necessary). Application of heat may also be helpful.

Total hip replacement in arthritis (whether RA or OA) is reserved for patients with severe pain or marked loss of mobility who have not responded to conservative measures. It is more suitable for patients over age 60, who typically engage in less vigorous physical activity and will place lower stress on the prosthesis.

Patients with hip fractures must be treated promptly to minimize the risk of non-union of bone fragments or of avascular necrosis from loss of blood supply. Adequate fixation of bone fragments can be achieved in most cases with pins, nails, screws, or plates. In the long run, however, successful treatment of hip fractures depends on the ability of the patient's bones to heal themselves. In patients at significant risk of non-union or avascular necrosis, and in patients with significant pre-existing hip disease from OA or RA, total hip replacement may be the appropriate initial treatment for hip fracture.

8.3 Description of Total Hip Replacement

Under general anesthesia, an incision is made in the side of the thigh and buttock. The muscles overlying the hip are cut to expose the joint capsule. The capsule is opened, and the femoral head is dislocated from the acetabulum. The femoral head and neck are removed with an oscillating saw. The cup-shaped acetabulum is enlarged and cleaned of bone and cartilage fragments. The *acetabular component* of the hip prosthesis is a cup made of two layers: a metallic outer shell, and an inner lining of polyethylene, which provides a smooth surface analogous in function to cartilage. The acetabular component is inserted into the pelvic bones and fixed, either with cement or with a bone graft. The *femoral component* of the hip

prosthesis replaces the femoral head and neck and is made entirely of metal. The stem of the femoral component is driven into a channel created in the shaft of the femur and is fixed with cement or bone grafts, leaving the prosthetic head and neck exposed. The round metallic head is inserted into the polyethylene socket of the acetabular component, recreating the ball-and-socket joint; the joint capsule, muscles, and tendons are reattached; and the wound is closed.

Following surgery, patients can be discharged to home within 10 days, but will need to undergo a lengthy rehabilitation process, including 6 to 12 weeks of walking with crutches (to avoid placing too much stress on the new hip prosthesis) and several months of progressive exercise to regain leg strength. Following rehabilitation, the vast majority of patients will have excellent pain relief and nearly normal hip function, with the ability to walk, climb stairs, get in and out of a car, and so forth. However, activities involving repetitive impact on the hip (such as jogging or playing tennis) may lead to early loosening of the prosthesis.

Early complications of total hip replacement include intra-operative damage to nerves, and post-operatively infection and development of blood clots (*deep venous thrombosis*) in the leg. In patients with deep venous thrombosis, a blood clot may travel from the leg to the lungs (*pulmonary embolism*), causing shortness of breath, chest pain, and even death. Late complications include loosening or failure (e.g., fracture) of one or both prosthetic components.

8.4 Changes in Technology Affecting Risk/Benefit Ratio

The hip is a simple joint, and mechanically satisfactory hip prostheses have been available for three decades. Recent technological advances have been focussed on reducing the incidence of complications following total hip replacement.

One of the most frequent and serious complications is loosening of prosthetic components. Until the 1980s, all hip prostheses were fixed to bone by acrylic cement. Unfortunately, this cement begins to fail after a period of time. On X-ray, 30 to 50 percent of cemented femoral components, and 10 to 15 percent of cemented acetabular components, will show evidence of loosening after ten years. Many of these patients will experience symptoms,

such as pain on walking, which increase in severity as loosening progresses. Ten to thirty percent of patients with hip replacements will require reoperation after 10 years, mostly because of loosening.

To solve the problem of loosening, two different approaches have been followed in the 1980s. One is to search for improved cements which last much longer. The second is the development of *cementless prostheses*. Two types of cementless prostheses are now in use. In *porous-coated* prostheses, the surfaces exposed to bone are covered with tiny metal beads or wires, allowing bone to bond to the prosthesis in much the same way that a bone fracture heals. Porous-coated prostheses require normal bone growth for good bonding, and are therefore more appropriate for younger patients. In *press-fit* prostheses, slots in the bone are cut to precisely mirror pins in the prosthetic surface, and the two surfaces interlock when they are pressed together. This method requires more technical skill and is not performed by all surgeons. Like porous-coated, press-fit prostheses are of greater benefit to younger patients.

A second, infrequent complication of total hip replacement is fracture of the femoral component. Over time, especially with partial loosening, small stress fractures may occur in the metal and grow until the prosthesis breaks completely. Newer, stronger metallic alloys are designed to reduce the incidence of prosthetic fracture.

Changes in medical therapy have occurred as well. Newer antibiotics and routine use of prophylactic antibiotics have reduced the incidence of post-operative infection. Routine use of anticoagulants has reduced the frequency of deep venous thrombosis and pulmonary embolism.

However, these advances in medical and surgical technology have probably had only a minor impact on utilization of total hip replacement in the elderly. An equally important influence may be an increase in the number of surgeons trained to perform total hip replacement. Nearly all orthopedic surgeons now gain some experience with THR during their residency training, and post-residency fellowships in THR are also available.

8.5 Changes in Indications for Hip Replacement

The indications for total hip replacement have been stable. Most hip replacements are done in patients with severe hip pain that limits their mobility. Patients with osteoarthritis

outnumber those with rheumatoid arthritis by about ten to one. A small number of THR procedures are revisions of old hip prostheses in patients with loosening, and an even smaller number are performed as primary treatment for hip fractures.

Although the indications for THR have not changed, it is possible that there has been some lowering of the threshold for surgery in terms of pain and loss of function, and that patients undergoing THR today may have slightly less severe disease than those of ten years ago. Nevertheless, total hip replacement is still reserved for patients with severe hip pain or dysfunction.

8.6 Shifts of Procedures to Ambulatory Settings

Total hip replacement is never performed in ambulatory settings.

8.7 Development of Clinical Guidelines for Total Hip Replacement

In 1990, the American Academy of Orthopaedic Surgeons published a set of six "clinical policies" on orthopedic conditions, including femoral neck fracture and osteoarthritis of the hip. The guidelines for femoral neck fracture state that total hip replacement may be appropriate for patients with hip fracture "who, in addition to the fracture, show evidence of osteoarthritis or rheumatoid arthritis of the hip or associated disorders," as well as for some patients "with increased risk for developing nonunion or osteonecrosis of [the] femoral head." The guidelines for osteoarthritis list total hip replacement as a therapeutic option, but conditions in which it is appropriate are not specified. Although these clinical policies were made available to some physicians beginning in 1989, it is unlikely that they had any measurable effect on utilization of total hip replacement.

8.8 Summary

Several non-price factors are likely to have favored increased utilization of total hip replacements in the late 1980s. First, the supply of physicians trained to perform the procedure has increased, since THR has been a standard part of the training in most

orthopedic residency programs since the early 1980s. Secondly, the pool of patients for whom THR is indicated has probably increased for three reasons: the threshold for performing hip replacement has probably been lowered slightly; the number of patients requiring repeat hip replacements (primarily because of loosened prostheses) is growing; and a small number of patients are receiving hip replacements as primary therapy for hip fractures.

REFERENCES

Clinical Policy: Femoral Neck Fracture (Adult). Park Ridge, Ill.: American Academy of Orthopaedic Surgeons, 1990.

Clinical Policy: Osteoarthrosis (Osteoarthritis, Degenerative Joint Disease of the Hip). Park Ridge, Ill.: American Academy of Orthopaedic Surgeons, 1990.

Harris WH, Sledge CB. Total hip and total knee replacement (first of two parts). New England Journal of Medicine 323(11):725-731 (September 13, 1990).

Kozinn SC, Wilson PD. Clinical Symposia: Adult Hip Disease and Total Hip Replacement. Summit, NJ: CIBA-Geigy Corporation, 1987.

Townes AS. Osteoarthritis, in [eds.] Barker LR, Burton JR, Zieve PD, Principles of Ambulatory Medicine (3rd edition). Baltimore: Williams & Wilkins, 1991.

Wigley FM. Rheumatoid arthritis, in [eds.] Barker LR, Burton JR, Zieve PD, Principles of Ambulatory Medicine (3rd edition). Baltimore: Williams & Wilkins, 1991.

9.0 TOTAL KNEE REPLACEMENT (TKR)

9.1 Relevant Anatomy and Pathology

In contrast to the hip, the knee is a complex joint. Two weight bearing bones, the *femur* and the *tibia*, meet at the knee. The principal motion at the knee is flexion and extension, and thus the knee superficially resembles a hinge. Unlike a hinge, however, the femur and tibia are not fixed rigidly to one another, but are held together by ligaments which allow not only flexion but limited rotation and side-to-side movement. The *anterior* and *posterior cruciate ligaments* bind the knee together and limit forward and backward movement. The *medial* and *lateral collateral ligaments* stabilize the knee on each side and limit side-to-side motion. In addition, the knee contains a third bone, the *patella*, which rides over the femur during flexion and extension. Cartilage covers the joint surfaces of the femur, tibia, and patella. In addition, two cartilaginous discs, the *medial* and *lateral menisci*, act as cushions between the femur and tibia.

The knee is affected by arthritis in much the same way as the hip. *Osteoarthritis* (OA), also called *degenerative joint disease* (DJD), most commonly affects the knees. It is more common in older patients. Contributing factors are excessive wear on the joints, obesity, and anatomical misalignments which cause uneven wear (such as "bow-leg" or "knock-knee" deformities). In OA, cartilage softens and thins, and may eventually erode completely, exposing bone at the joint surface. The medial and lateral menisci can tear as a result of degenerative disease, creating loose fragments of cartilage in the joint. Abnormal bone growth also occurs (*bone spurs*). Symptoms typically include deep aching, stiffness, and (in advanced cases) limitation of movements such as using stairs, getting out of chairs, or even walking. Loose fragments of bone or cartilage may cause "locking" of the knee or sudden increases in pain.

Rheumatoid arthritis (RA) is much less common than osteoarthritis. Unlike OA, it is a systemic illness, affecting many body systems in addition to the joints. RA nearly always affects both knees at the same time, causing painful swelling and destruction of joint cartilage. Like OA, RA affecting the knees can severely restrict mobility.

9.2 Indications for Total Knee Replacement

Osteoarthritis of the knee is treated conservatively by a proper balance of rest and activity; by oral analgesics or non-steroidal anti-inflammatory agents; by application of moist or dry heat; and by weight reduction and correction of anatomic misalignment (e.g., by orthopedic shoes) if indicated. Injections of corticosteroids into the joint space are also sometimes helpful.

Medical therapy of rheumatoid arthritis attempts to control the generalized inflammatory process causing symptoms in joints and other areas. One or more agents from several classes of drugs are used, including non-steroidal anti-inflammatory agents (aspirin, ibuprofen, etc.); oral corticosteroids (prednisone); and other drugs (gold compounds, immunosuppressive agents).

Arthroscopic surgery can also offer some relief to patients with arthritis of the knee. Bone spurs and fragments of cartilage can be removed arthroscopically. Uneven areas of cartilage can be abraded to eliminate irregularities, and torn menisci can be removed. Arthroscopic surgery, however, is a temporizing approach, since it does not arrest the continuing destruction of joint cartilage by either degenerative (OA) or inflammatory (RA) processes. Patients may have improvement or elimination of arthritic symptoms for months or a few years after arthroscopic surgery, but most will require further medical or surgical therapy.

In total knee replacement, the degenerative or inflammatory arthritic process is halted because the substrate (joint cartilage) is completely removed and replaced. However, because TKR is a major surgical procedure involving significant risks, costs, and rehabilitation, it is indicated only for patients with severe pain and/or marked restriction of activity who are not helped by more conservative medical therapy. It is usually reserved for older, less active patients, since vigorous physical activity can lead to loosening and failure of the knee prosthesis.

9.3 Description of Total Knee Replacement

The joint capsule is exposed and opened. Both collateral ligaments are preserved. Because it significantly contributes to joint stability, the posterior cruciate ligament is usually kept as well. However, the anterior cruciate ligament is generally cut to facilitate access to the joint. The joint surfaces of the femur and the tibia are trimmed and shaped with a saw and other instruments to accommodate the prosthetic joint surfaces.

The knee prosthesis itself consists of three separate parts: the *femoral*, *tibial* and *patellar* components. Essential to knee replacement, the femoral and tibial components are extremely durable substitutes for the biologic joint surfaces of the femur and tibia, with nearly the same shape. These two components are attached only to bone, not to each other; however, once installed, they will be held firmly in contact with each other by the knee's own ligaments (in most cases, by the two collateral ligaments and the posterior cruciate). The femoral and tibial prosthetic components can be attached to bone by cement or by one of two cementless techniques. The patellar component is used at the discretion of the surgeon. In patients with RA, the patella is usually replaced by a polyethylene button. In OA, it may or may not be replaced, depending on the condition of the patellar cartilage and how well it glides against the femoral prosthesis.

Following surgery, most patients have excellent relief from pain and nearly normal range of motion in the knee. A rehabilitation period lasting several months is required to regain strength in the leg muscles.

Early complications of total knee replacement include infection, and blood clots in the leg (*deep venous thrombosis*) which may travel to the lung (*pulmonary embolism*), causing shortness of breath, chest pain, or even death. The risk of these complications is reduced by the prophylactic use of antibiotics and anti-coagulants.

As with total hip replacement, prosthetic failure is a potential long-term complication of knee replacement. The patella or patellar prosthesis may become dislocated or may fracture. In about five percent of TKRs, one of the other components (almost always the tibial prosthesis) will loosen from bone within ten years, requiring surgical revision of the knee replacement.

9.4 Changes in Technology Affecting Risk/Benefit Ratio

Because the knee is mechanically more complex than the hip, satisfactory knee prostheses took much longer to develop. Extensive computer-assisted analysis and laboratory testing were required to understand the mechanical forces transmitted through the knee during normal motion, and to design prosthetic components and materials which could withstand these forces over long periods of time, while offering at the same time both stability and a normal range of motion. Early knee prostheses used in the 1960s and 1970s were hinged; this rigid connection between the femur and tibia resulted in high rates of loosening of prostheses. In modern knee prostheses, the only attachments between the femur and the tibia are the natural ligaments. Other design changes affected the distribution of load as body weight is transferred from the femur to the tibia. These improvements occurred largely in the early and mid-1980s. Today, knee prostheses provide outcomes that are at least as reliable and satisfactory as hip prostheses in relieving pain and allowing nearly normal mobility. These improvements in the design of knee prostheses markedly increased the benefits of total knee replacements, and are directly linked to increased utilization of the procedure in the late 1980s.

Of course, improvements in medical therapy contributed to the improved outcomes of TKR by reducing the risk of deep venous thrombosis and pulmonary embolism through the use of anti-coagulants, and by reducing the risk of post-operative complications with routine use of prophylactic antibiotics.

As with total hip replacement, some controversy exists over the best way to attach knee prostheses to bone. Both porous and press-fit cementless prostheses have been tried in the knee with varying success. Experience has shown, however, that cemented knee prostheses are well suited to older, less active patients, and development of cementless techniques is not expected to affect utilization substantially in the older population.

9.5 Changes in Indications for Knee Replacement

Total knee replacement is indicated in only a limited number of conditions, primarily osteoarthritis and rheumatoid arthritis. In this sense, indications have not changed. However, the availability of reliable, mechanically satisfactory prostheses means that TKR is no longer

thought of as an experimental therapy or as a last resort for patients with severe pain. There has thus been a dramatic increase in the number of patients for whom this surgical treatment is appropriate.

9.6 Shifts of Procedures to Ambulatory Settings

Total knee replacement is never performed in ambulatory settings.

9.7 Development of Clinical Guidelines for Total Knee Replacement

No guidelines have been published regarding the use of total knee replacement.

9.8 Summary

Total knee replacement is a technology which has offered satisfactory outcomes only since the mid-1980s. It is indicated in only a small percent of patients with osteoarthritis and rheumatoid arthritis - those whose mobility is limited by severe pain unresponsive to medical therapy. However, since one of these conditions (osteoarthritis) is very common in the elderly, the number of Medicare patients who may benefit from this procedure is considerable. Recent increases in the utilization of this procedure are attributable to technological improvements since 1980 which offer improved quality of life to those with disabling arthritis of the knee.

REFERENCES

- Ewald FC, Walker PS. The current status of total knee replacement. Rheumatic Disease Clinics of North America 14(3):579-590 (December 1988).
- Friedman RJ, Poss R. Revision total knee arthroplasty in patients with osteoarthritis. Rheumatic Disease Clinics of North America 14(3):537-544 (December 1988).
- Harris WH, Sledge CB. Total hip and total knee replacement (second of two parts). New England Journal of Medicine 323(12):801-807 (September 20, 1990).

10.0 KNEE ARTHROSCOPY

10.1 Relevant Anatomy and Pathology

The knee is a complex joint with several important structures. The *femur* and the *tibia* are long, weightbearing bones which meet at the knee. The *patella* is a non-weightbearing bone which is attached to muscle tendons and glides over the femur at the knee. The joint surfaces of each of these three bones is covered by cartilage which can be damaged by trauma, inflammation, or degeneration associated with age and excessive wear.

The knee is divided into *medial* and *lateral compartments* by two thick ligaments which cross the middle of the knee from front to back. These are the *anterior* and *posterior cruciate ligaments*, which bind the femur and the tibia together and limit their movements against one another. The medial and lateral compartments each contain a *meniscus*, a cartilaginous disc which helps absorb the impact of the femur against the tibia. Like the cartilage which lines bone surfaces, these *medial* and *lateral menisci* can be damaged by trauma, inflammation, and degenerative processes.

The knee joint is stabilized on each side by the *medial* and *lateral collateral ligaments*, which prevent excessive side-to-side bending. The knee is surrounded by a fibrous *joint capsule*. The capsule is lined by a *synovial membrane* which secretes *synovial fluid* (joint fluid).

10.2 Indications for Knee Arthroscopy

In older patients, the most common derangement in the knee is *osteoarthritis* (OA), also known as *degenerative joint disease* (DJD). Common risk factors for the development of OA are obesity and anatomical abnormalities of the legs ("bow-leg" and "knock-knee" deformities). Osteoarthritis can usually be diagnosed simply from the patient's complaints of stiffness and aching, and from a physical exam characterized by pain and "cracking" in the knee, without evidence of inflammation or infection.

The knee may also be affected by *rheumatoid arthritis* (RA), which is less common than OA. Most elderly patients with RA will have multiple joint involvement, evidence of

swelling and inflammation on physical examination, and histories of symptoms and treatment going back several years.

Progression of arthritis (whether RA or OA) can be followed by physical examination and by routine X-rays of the knee, which may demonstrate abnormal bone formation and erosion of bone, both common processes in arthritis. These diagnostic techniques are adequate for the care of arthritic patients with uneventful courses who are responding adequately to non-surgical therapy.

However, X-ray studies (whether plain films or CT) give very little direct information about the condition of ligaments or cartilage. MRI scanning (which does not use X-rays) does image joint cartilage and ligaments, and has been used successfully to diagnose meniscal tears and torn cruciate or collateral ligaments (e.g., following sports injuries). Knee arthroscopy, however, is recognized as the definitive technique for examining cartilage and ligaments within the knee. The arthroscopist can see directly virtually all aspects of surface structures within the knee. Among the elderly, this invasive procedure is most useful diagnostically in arthritic patients with moderate to severe symptoms that do not respond well to conservative (non-surgical) therapy, and in those who have a dramatic worsening of symptoms. In addition, arthroscopy can be used therapeutically in the knee to remove abnormal cartilage or bone that may be causing severe pain or interfering with activity. Because of this therapeutic potential, arthroscopy serves as a nearly complete substitute for open surgery of the knee (*arthrotomy*), and can be used to postpone the need for total knee replacement.

10.3 Description of Knee Arthroscopy

The arthroscope, like other endoscopes, is a flexible tube containing glass fibers which transmit light from an external source to its tip, illuminating the area under examination, and then return an image to the surgeon. The tip of the arthroscope can be controlled by the surgeon to provide a wide range of view within the joint.

Arthroscopy may be performed using a variety of anesthetic techniques. Most commonly, a combination of local anesthesia and intravenous sedation are used. General anesthesia may be used in patients who are extremely anxious.

When general or regional anesthesia is not employed, a local anesthetic is injected into the skin at three sites: on either side of the knee (the *medial* and *lateral ports*), and the upper border of the patella. A needle is then inserted above the patella so that the joint can be irrigated as needed by saline solution. Small incisions, about one half inch long, are made at the medial and lateral ports. The arthroscope is inserted first through the lateral port and later through the medial port. (The knee must be entered in two different places because the cruciate ligaments divide the knee into two separate compartments.) Ligaments, joint cartilage, and the meniscus in each compartment is examined visually. Therapeutic maneuvers may be performed by inserting instruments through one of the ports. For example, forceps may be used to extract bits of bone or cartilage; a rotating burr may be used to grind down roughened cartilage. Sterile saline solution from the third port is used to flush the joint periodically to clear bloody fluid and debris. When all diagnostic and therapeutic arthroscopic procedures are complete, the three small incisions are closed with sutures or with adhesive strips. When arthroscopy is performed for diagnosis only, it can be completed in thirty minutes or less. Therapeutic arthroscopy requires somewhat longer, but is still a relatively brief procedure.

Patients are usually able to walk as soon as they have recovered from effects of medication (intravenous sedation, or general or regional anesthesia), usually within a few hours. Most will have postoperative pain, which can be treated by applying ice, elevating the leg, and using oral analgesics. Most patients will also need to use crutches for support for one or more days; weightbearing will be more painful in those who have undergone more extensive therapeutic procedures.

Complications of arthroscopy include infection, formation of blood clots in the leg (*deep venous thrombosis*, or *DVT*) which occasionally travel to the lung (*pulmonary embolism*), and injury to nerves as they cross the knee area. These complications, however, are infrequent. Intravenous antibiotics are often used during arthroscopy to prophylax against infection. No particular precautions are needed for DVT, since the surgical procedure is brief and patients are up and about within 12 to 24 hours. Good surgical technique minimizes the incidence of nerve damage.

A rare complication of arthroscopy is *reflex sympathetic dystrophy* (RSD), a poorly understood condition characterized by chronic leg pain and lasting up to a year or

more. Its cause is unknown. When it occurs, it is treated with varying success by nerve blocks, physical therapy, and anti-depressants.

10.4 Changes in Technology Affecting Risk/Benefit Ratio

Several improvements in the design of the arthroscope itself have altered the risk/benefit ratio of the procedure. Arthroscopes used in the knee are now less than half a centimeter in diameter, requiring smaller incisions which heal faster. Videoscopic arthroscopes have been in use since the early 1980s; technological improvements since then have reduced the video component of these scopes to the size of a cellular telephone. Procedures performed with videoscopes can be displayed on monitors, allowing physicians in training (and patients if they wish) to view any abnormal findings and therapeutic maneuvers. Such procedures can also be videotaped for retrospective review of findings and treatment. Since about 1986, printers have been available which attach to the video cameras, allowing "freeze frame" images of the procedure to be printed instantly, again improving communication with patients and other physicians. However, because they are significantly more expensive than standard arthroscopes, videoscopes are usually found only in teaching hospitals and large community hospitals.

The previously described technological advances, however, are unlikely to have had a great influence on utilization of arthroscopy. More significant in this regard is the development of new therapeutic techniques which extend the clinical applications of arthroscopy. Prior to 1985, arthroscopy was being used to remove loose fragments of cartilage, or to trim the frayed edges of degenerative menisci (*subtotal meniscectomy*). Since then, improvements have occurred in instruments used within the knee - the scissors, trimmers and grabbers used within the knee joint - which have widened the range of knee procedures which can be performed arthroscopically.

The most important new therapeutic use in the Medicare population is *abrasion arthroplasty*. In this procedure, a rotating burr is used to remove degenerative cartilage from joint surfaces in the knees of patients with OA. The cartilage is abraded until bone can be seen. Within several weeks, the bared areas of bone will have been completely resurfaced with a smooth coat of fibrocartilage which, although not as durable as normal joint cartilage,

will usually allow pain-free mobility of the knee joint for an extended period of time.

Abrasion arthroplasty is most successful when only limited areas of cartilage are treated. For more extensive disease, total knee replacement may be appropriate. Furthermore, abrasion arthroplasty is a temporizing measure: most patients will eventually have recurrence of joint pain as the degenerative process continues. Despite these limitations, abrasion arthroplasty has been an increasingly popular procedure, since severe knee pain can often be alleviated by this ambulatory surgical procedure for two years or more, postponing the need for more extensive surgery such as knee replacement.

Another relatively new technology, MRI, may decrease the utilization of knee arthroscopy by substituting for it. MRI is able to image ligaments and cartilage since it does not use X-rays. (Bone, because it is much more radiopaque, obscures adjacent cartilage and ligaments in X-ray studies.) Clinical research has been conducted comparing MRI with arthroscopy in diagnosing non-bony disorders in the knee. One study found that in patients with meniscal tears, MRI was highly sensitive, detecting abnormalities in 90 to 97 percent of patients with tears. However, its specificity was lower (77 to 87 percent). Thus, while a normal MRI scan may help avoid arthroscopy, patients with abnormal scans may still require arthroscopy to determine the exact nature of the abnormality. The precise role of MRI in diagnosing disorders of the knee is still being defined, and most physicians still regard arthroscopy as the "gold standard." Furthermore, MRI is a strictly diagnostic tool; when pathology amenable to arthroscopic intervention is suspected, arthroscopy is preferable to MRI. Finally, since the cost of an MRI scanner exceeds that of an arthroscope by orders of magnitude, arthroscopy is more widely available than MRI. For these reasons, MRI would have caused only a limited decrease in the utilization of knee arthroscopy before 1989.

10.5 Changes in Indications for Knee Arthroscopy

In the Medicare population, arthroscopy is still used primarily in patients with osteoarthritis and in those with rheumatoid arthritis. Thus, the number of disease entities in which arthroscopy is used has not changed. However, the applications for arthroscopy within these two diseases have broadened considerably with the development of therapeutic arthroscopic procedures.

10.6 Shifts of Procedures to Ambulatory Settings

Because arthroscopy is a brief procedure requiring minimal restriction in activity postoperatively, it has always been performed to some extent as an ambulatory procedure. However, as recently as 1985, about half of patients undergoing the procedure were hospitalized for one night postoperatively. Because of changes in payer regulations since the mid-1980s, arthroscopy is now performed almost exclusively as an ambulatory procedure. Ordinarily, patients are admitted only for medical complications such as cardiac arrhythmia or markedly elevated blood sugar.

10.7 Development of Clinical Guidelines for Knee Arthroscopy

No clinical guidelines have been published for knee arthroscopy.

10.8 Summary

Knee arthroscopy has achieved wide acceptance as both a diagnostic and therapeutic tool for Medicare patients with osteoarthritis and rheumatoid arthritis. When it was introduced, it provided an excellent alternative to the unsatisfactory extremes of plain X-rays and open arthrotomy as diagnostic procedures. Since its introduction, it has also almost entirely replaced open arthrotomy as a therapeutic technique in elderly patients, since the abnormalities associated with OA and RA in the knee (diseased cartilage, abnormal bony growths, and thickened joint lining) can all be treated arthroscopically. While MRI has been a partial substitute as a diagnostic tool, any resulting decrease in the diagnostic use of arthroscopy is likely to have been outweighed by growth in therapeutic uses, such as abrasion arthroplasty.

REFERENCES

- Kelly MA, Flock TJ, Kimmel JA, Kiernan HA, et al. MR imaging of the knee: clarification of its role. Arthroscopy 7(1):78-85 (1991).
- Metcalf RW. Arthroscopic knee surgery. Advances in Surgery 17:197-240 (1984).
- Minkoff J, Putterman E. The unheralded value of arthroscopy using local anesthesia for diagnostic specificity and intraoperative corroboration of therapeutic achievement. Clinics in Sports Medicine 6(3):471-490 (July 1987).
- Schonholtz GJ. Arthroscopic debridement of the knee joint. Orthopedic Clinics of North America 20(2):257-263 (April 1989).
- Sherman OH. The perioperative management of the arthroscopic patient. Clinics in Sports Medicine 6(3):491-502 (July 1987).



11.0 PERMANENT CARDIAC PACEMAKER IMPLANTATION

11.1 Relevant Anatomy and Pathology

In the normal heart, cardiac impulses are initiated in the right atrium by a group of cells with intrinsic pacemaker activity known as the sino-atrial (SA) node. Each electrical impulse generated by the SA node spreads rapidly throughout the right and left atria, stimulating atrial contraction. It then reaches the atrio-ventricular (AV) node, a specialized conducting tissue which slows the electrical impulse substantially. The impulse is finally transmitted to the ventricles, stimulating ventricular contraction.

The right and left atria act somewhat like reservoirs for blood returning to the heart. Normal contraction of the atria results in rapid filling of the ventricles, allowing for more efficient cardiac function. Blood circulation throughout the lungs and the body is the result of forceful contraction of the right and left ventricles.

When the SA node is functioning normally, the heart rate is influenced by the nervous system and by circulating hormones, and increases with exercise and stress. When the AV node and other components of the conduction system are functioning normally, contractions of the atria and ventricles are coordinated, providing rapid ventricular filling and increased cardiac output.

11.2 Indications for Permanent Cardiac Pacemaker Implantation

The most common indications for pacemaker insertion are dysfunction of the SA node ("sick sinus syndrome") and AV node disease. In *SA node dysfunction*, the intrinsic cardiac pacemaker discharges erratically, at times causing an abnormally slow heart rhythm (bradycardia, or heart rate less than 60 beats per minute) and at times a rapid rhythm (tachycardia, or heart rate over 100). Because of its distinctive conduction properties, a properly functioning AV node can often mitigate the effects of tachycardia caused by SA node disease, for example by transmitting only every other impulse to the ventricles. Bradycardia, however, is likely to significantly reduce blood flow to major organs, resulting in symptoms such as dizziness, lightheadedness, exercise intolerance, congestive heart failure, and syncope

(sudden, brief periods of unconsciousness). Pacemakers are routinely used in patients with symptomatic bradycardia; a heart rate under 60 without symptoms is not a sufficient indication for pacemaker insertion.

There are three categories of *AV node dysfunction*. In *first-degree AV block*, conduction of electrical impulses to the ventricles is delayed abnormally. In *second-degree block*, some impulses (perhaps every other or every third) are blocked from reaching the ventricles. In *complete (third-degree) heart block*, no impulses from the intrinsic pacemaker reach the ventricles.

Even when intrinsic pacemaker rate is normal, AV node disease can substantially decrease the impulses transmitted to the ventricles, resulting in bradycardia or pauses, and (as with bradycardia caused by SA node dysfunction) causing dizziness, lightheadedness, syncope, or other symptoms. The incidence of AV node dysfunction increases with age; the condition also occurs in many patients following acute myocardial infarction. It can also be caused by many drugs used to treat congestive heart failure (digitalis) or to control angina and hypertension (beta-blockers such as propranolol; calcium channel blockers such as verapamil and nifedipine). Such drug-associated AV dysfunction is more common in the elderly, many of whom may already have age-associated impairment of conduction.

First-degree heart block by itself is never an indication for permanent pacing. Pacemakers are indicated in patients with symptomatic bradycardia resulting from second- or third-degree heart block, and also in certain asymptomatic patients with heart block who are at increased risk for sudden death from cardiac arrest. If AV block is related to drug therapy, alternative drug regimens may be explored; however, in some patients, permanent pacing and continuation of drugs (despite AV block) may constitute the best medical management.

11.3 Description of Procedure

Permanent pacemakers consist of two parts: a pulse generator, and one or two long wire pacing electrodes. The pulse generator contains a power supply and electronic devices to sense the patient's own heart beats and to supply artificial or "paced" beats when necessary.

The pulse generator is implanted in the chest wall. In nearly all cases, the electrodes are passed transvenously under fluoroscopic guidance from the pulse generator to the interior of the heart, where they become embedded in the wall of the heart. The procedure is usually performed under local anesthesia, most often in inpatient settings to allow for adequate observation of the patient and monitoring of pacemaker function.

Bleeding and local discomfort are the most common complications. Infection occurs rarely. Other uncommon complications are deep venous thrombosis, pulmonary embolism, displacement or fracture of the electrodes, and premature failure of the pulse generator. Patients require routine follow-up to ensure proper pacemaker function, especially near the end of the battery's expected life. Power supplies, pulse generators, and pacemaker wires can be replaced if necessary.

11.4 Changes in Technology

The first fully implantable cardiac pacemaker was developed in 1959. Permanent cardiac pacemaker technology has advanced rapidly over the past 30 years. Pacemakers are now smaller, lighter, and have longer-lasting power supplies (5 to 10 years). They can also be reprogrammed after implantation, using externally applied magnets or radio waves, so that the function of a single implanted pacemaker may change as the nature of the patient's cardiac disease changes. Many newer pacemakers can transmit information via telephone to a physician's office, allowing for easier monitoring of pacemaker function.

The first pacemakers were relatively simple devices which discharged at a constant rate to stimulate ventricular contraction. Now, all artificial pacemakers perform two functions: first, to sense the heart's own spontaneous electrical discharges, and second, to initiate artificially paced beats as necessary. Pacemakers which sense the heart's spontaneous beats and respond appropriately are called demand pacemakers. All modern pacemakers are of this type.

Artificial pacemakers also have several possible "modes of response." In the commonly used *inhibited* mode, a spontaneous electrical discharge originating in the heart will, if sensed properly by the pacemaker, inhibit the pacemaker from discharging for a very brief

interval. As long as the heart's intrinsic pacemaker is functioning adequately, the artificial pacemaker will not discharge. Pacemakers can also be reprogrammed to operate in *triggered* or *asynchronous* modes. These modes are used primarily to adjust the sensitivity and output of pacemakers.

Older pacemakers were designed to sense spontaneous discharges only in the ventricles and to provide artificially paced beats only to the ventricles. Pacemakers of this type are referred to as single-chamber or VVI (for ventricular-paced, ventricular-sensed, inhibited). Although they certainly saved many lives, VVI pacemakers were also associated with some side effects. When only the ventricles are paced, atrial contraction may occur but will not be synchronized properly with ventricular contraction. For some patients, the loss of atrial contribution to ventricular filling results in decreased exercise tolerance. Other patients experience a drop in blood pressure, dizziness, or syncope when an implanted VVI is artificially pacing the heart; these patients are said to have a "pacemaker syndrome."

Around 1985, pacemakers became available which could sense spontaneous discharges in the atria as well as in the ventricles, and could also provide electrical discharges to both the atria and ventricles. They can operate in both inhibited and triggered modes. These pacemakers are called dual-chamber, AV-sequential, or DDD devices (for dual-sensed, dual-paced, dual mode). DDD pacemakers can provide physiologic sequential pacing of the atria and ventricles, improving exercise tolerance in some patients. They also eliminate the pacemaker syndrome. However, they are substantially more expensive, more difficult to implant (since both atrial and ventricular leads must be positioned correctly), and require more time for programming and follow-up than VVI pacemakers.

VVI and DDD pacemakers are the two types of pacemakers most commonly used today. DDD pacemakers do offer clinical advantages in some patients. However, for most patients, the difference between VVI and DDD devices is a marginal one. While DDDs account for an increasing share of initial pacemaker implants, their advantages are not sufficient to warrant large-scale replacement of older VVI implants with DDDs. Furthermore, although DDDs may improve exercise tolerance in some patients, they do not expand the clinical applications in which pacemakers are used: both VVIs and DDDs are used primarily

in patients with bradycardia from SA or AV node dysfunction. For these reasons, the introduction of DDD pacemakers is unlikely to be responsible for a significant increase in pacemaker implantation.

11.5 Changes in Indications for Pacemaker Implantation

In the 1960s, most pacemakers were being inserted for AV block. By 1989, the most common indication for pacemaker insertion was SA node dysfunction. In either case, pacemakers were inserted to prevent symptoms from bradycardia and pauses, and prevention of such symptoms remains the primary purpose of pacemakers. However, the rate of pacemaker implantation for bradycardia is likely to increase in Medicare beneficiaries for two reasons. First, the incidence of conduction disorders is growing along with the "old old" segment of the population. Cardiologists are likely to have become more aggressive in treating bradycardia with pacemakers in these patients because of the low morbidity and excellent outcomes expected with the procedure. Second, the use of drugs affecting AV node conduction is growing, and has undoubtedly increased the number of patients in whom permanent pacing is indicated, especially in the very old.

In the 1980s pacemaker technology was applied to the treatment of tachycardia as well as bradycardia. Rapid, precisely-timed artificially paced beats can often interrupt an abnormal rapid heart rhythm, if the pacemaker is sophisticated enough to detect the rapid arrhythmia and to respond with appropriately timed discharges. Pacemakers have also been designed which incorporate cardioverters and defibrillators, devices which deliver larger electrical shocks to the heart to terminate more erratic arrhythmias. However, in the period 1985 to 1989, pacemakers incorporating these technologies were still considered experimental by the FDA, and would not account for any increase in pacemaker insertion under Medicare.

A separate technology which deserves mention is the *automatic implantable cardiac defibrillator* (AICD). These devices also are designed to terminate erratic and life-threatening cardiac arrhythmias, and have been in clinical use since the mid-1980s. However, unlike pacemakers, AICDs are not designed to treat bradycardia by sensing and pacing the atria and/or ventricles. AICDs represent a separate and distinct technology and are never

billed as pacemaker insertions; specific codes for billing AICD implantation first appeared in the 1987 edition of the AMA's Physicians' Current Procedural Terminology (CPT), published in November 1986.

11.6 Shifts of Procedures to Ambulatory Settings

Permanent pacemaker implantation is nearly always performed in inpatient settings because of the need for intensive monitoring and adjustment of the pacemaker following implantation. Little shift of primary implantations to ambulatory settings is expected to have occurred between 1985 and 1989. However, battery replacement (a procedure not included in this study) is routinely performed in ambulatory settings.

11.7 Development of Clinical Guidelines for Pacemaker Implantation

In 1984 the American College of Cardiology and the American Heart Association jointly published a set of guidelines for permanent cardiac pacemaker implantation. In these guidelines, indications for pacemaker implantation were labeled as:

- Class I: Conditions for which there is general agreement that permanent pacemakers should be implanted;
- Class II: Conditions for which permanent pacemakers are frequently used but there is divergence of opinion with respect to the necessity of their insertion; or
- Class III: Conditions for which there is general agreement that pacemakers are unnecessary.

The guidelines discussed pacemaker indications with a great deal of clinical detail and specificity, and might have had some effect on utilization by themselves. However, their influence on practice was undoubtedly magnified by HCFA's directive to Peer Review Organizations in January 1986 regarding permanent pacemaker implantation. The directive mandated PRO review of every case of permanent pacemaker insertion to determine if the procedure was "reasonable and necessary," based on clinical information in the hospital admission record. Pacemaker implantations which did not meet PRO standards resulted in

denial of reimbursement to the physician, and even denial of the hospital admission if pacemaker insertion was the sole reason for admission. PRO enforcement of clinical guidelines by withholding reimbursement likely had a significant impact on pacemaker insertion in patients with marginal indications (for example, patients who were not clearly symptomatic from their bradycardia).

11.8 Summary

Although pacemaker technology has evolved significantly over the past 30 years, improvements prior to 1990 did not significantly expand the application of pacemakers to a wider pool of patient. However, demand for pacemaker utilization under Medicare between 1985 and 1989 was undoubtedly influenced by increasing use of drugs affecting cardiac conduction, and by the growing numbers of very old in the population. PRO enforcement of clinical guidelines for pacemaker insertion, beginning in 1986, is likely to have moderated increases in utilization by discouraging the procedure in marginal cases.

REFERENCES

- American College of Cardiology and American Heart Association. Guidelines for permanent cardiac pacemaker implantation. Journal of the American College of Cardiology 4(2):434-442 (August 1984).
- Das G, Carlblom D. Artificial cardiac pacemakers. International Journal of Clinical Pharmacology and Therapeutic Toxicology 28(5):177-189 (May 1990).
- Denditt DG, Milstein S, Buetikofer J, Gornick CC, Mianulli M, Fetter J. Sensor-triggered, rate-variable cardiac pacing. Annals of Internal Medicine 107(5):714-724 (November 1987).
- Kowey PR, Mullan DF, Wetstein L. Pacemaker therapy. Surgical Clinics of North America 65(3):595-611 (June 1985).
- Ludmer PL, Goldschlager N. Cardiac pacing in the 1980s. New England Journal of Medicine 311(26):1671-1680 (December 27, 1984).

12.0 TRANSURETHRAL (TURP) AND SUPRAPUBIC PROSTATECTOMY (SP)

12.1 Relevant Anatomy and Pathology

The prostate is shaped like an inverted pyramid and is located directly below the bladder. It contains both muscle fibers and glandular tissue. The glandular secretions of the prostate constitute most of the volume of semen. Contraction of the muscle fibers causes emptying of glandular secretions during ejaculation. Anatomically, five rather indistinct *lobes* of the prostate have been described: *anterior, median, posterior*, and two *lateral* lobes. Functionally, the prostate consists of two concentric layers, derived from different embryonic tissues: the *inner zone* and *peripheral zone* both contain prostatic glands, but are separated by a distinct layer of muscle. The entire prostate is surrounded by a fibrous *capsule*. The urethra, as it travels from the bladder to the penis, passes through the center of the prostate for about an inch; this section is called the *prostatic urethra*.

One of the most common conditions affecting the prostate is *benign prostatic hypertrophy (BPH)*, an abnormal but non-cancerous enlargement of the prostate. A normal prostate is about the size of a walnut; with BPH, it can double in size. The condition occurs primarily in men over age 45. In autopsy studies, more than half of men over age 50, and 90 percent of men over age 70, have evidence of BPH. It is associated with increasing age and normal levels of male hormones, but other etiologic factors are unknown. In BPH, it is the inner zone of the prostate that *hypertrophies* (grows abnormally large). Most of the symptoms of BPH are attributable to compression of the prostatic urethra, causing difficulty and delay in emptying the bladder (*bladder outlet obstruction*). The bladder often does not empty completely, and the resulting stagnant urine may lead to recurrent bladder infection. With chronic obstruction, the bladder must contract more forcefully to empty itself. As a result, the muscular wall of the bladder thickens (hypertrophies) and becomes overly sensitive (hyper-reflexic). The hypertrophied, hyper-reflexic bladder then gives rise to irritative symptoms: sudden and frequent urges to urinate, especially at night. Fragile, dilated veins within the enlarged prostate can bleed intermittently, causing visible or invisible blood in the

urine (*gross or microscopic hematuria*). As obstruction grows more severe, the increase in urinary pressure causes progressive enlargement of the bladder, ureters, and kidneys, with gradual loss of kidney function. Thus, BPH is not merely an inconvenience: if left untreated, it will eventually cause renal failure in a minority of patients.

12.2 Indications for Prostatectomy

Many men tolerate mild to moderate symptoms of prostatic obstruction for years. Symptoms may wax and wane over time, especially with changes in medications prescribed for other conditions (decongestants, anti-anxiety agents, some anti-arrhythmics, and other drugs). In fact, within the past few years many urologists have begun using a few of these medications to manage the symptoms of BPH.

For patients with severe obstruction of the urinary tract, the only effective treatment of BPH is the surgical removal of prostatic tissue, eliminating compression of the prostatic urethra. Such surgery will prevent or halt physiologic consequences of obstruction, such as hypertrophy of the bladder and deterioration of kidney function. However, the majority of prostatectomies are performed electively in patients who have moderate obstructive and irritative symptoms (frequent urination, difficulty voiding, and so forth), but who are not at immediate risk for renal damage.

12.3 Description of Prostatectomy

Several different surgical techniques have been developed for prostatectomy. These can be classified by the anatomical approach (transurethral, suprapubic, retropubic, and perineal*), or by the extent of surgery (simple or radical). In a radical prostatectomy, the entire prostate (including the capsule) is removed, along with the seminal vesicles and surrounding tissue. Radical prostatectomies are performed only in patients with prostatic

*Transurethral prostatectomy is an endoscopic procedure; the other three are referred to as "open" prostatectomies.

cancer. In a simple prostatectomy, only the glandular tissue is removed, leaving the prostatic capsule and surrounding tissues intact. Only the two most common types of simple prostatectomy, transurethral and suprapubic, will be discussed here.

12.4 Transurethral Prostatectomy (TURP)

Transurethral prostatectomy is the most common surgical technique, accounting for more than 90 percent of prostatectomies in the United States. Basically, a TURP involves the endoscopic cutting and removal of prostatic tissue, using the urethra as the endoscopic route to the prostate. Because this endoscopic surgery requires special training, all TURPS are performed by urologists.

The endoscope used in this procedure is called a *resectoscope*, a thin rigid tube which contains three components: optical elements for viewing the prostate, channels for the passage of fluids, and a wire probe which ends in a loop. An electric current is passed through the loop, which is used to "cut" prostatic tissue. Small, repeated semi-circular passes are made with the loop, concentrically enlarging the intraprostatic urethral channel by chipping away at peri-urethral tissue (the inner zone of the prostate), and continuing until as much glandular tissue as possible has been removed. (The process may be likened to removing the flesh of an orange with a tiny spoon, until only the intact skin is left.) In order to maintain visibility, prostatic tissue and blood are removed by continuous or intermittent irrigation of the prostate with fluid through the resectoscope. The procedure may last from 30 to 90 minutes, depending on the size of the prostate and the amount of bleeding that occurs.

Spinal anesthesia is used in about 90 percent of cases, and general anesthesia in the remaining 10 percent. (Patient preference is the usual reason for using general anesthesia.) When the procedure is finished, a catheter is inserted into the bladder to drain urine (both anesthesia and obstruction-related stretching may decrease muscle tone of the bladder) and to flush out blood (which may otherwise form clots and obstruct urine flow). The catheter is removed when the urine is clear of blood, usually within 24 to 72 hours. The average length of stay for TURP patients is four to five days.

12.5 Suprapubic Prostatectomy

This is an older surgical technique which has greatly decreased in popularity during the past two decades. Unlike TURP, suprapubic prostatectomy is not an endoscopic procedure. Currently, it is usually reserved for patients with very large prostates which would be difficult to remove endoscopically. Since it does not require special endoscopic training, non-urologists may perform suprapubic prostatectomies; in practice, however, nearly all are performed by urologists.

In the suprapubic approach, the lower abdominal wall is incised, revealing the bladder. The bladder is opened, and the floor of the bladder is then cut to expose the prostate lying beneath the bladder. Using a finger, the surgeon can easily separate and remove the glandular portion of the prostate from the fibrous prostatic capsule. Removal of the prostate gland is usually more rapid and more complete using the suprapubic approach.

Surgical incisions in the floor and the anterior wall of the bladder and in the abdominal wall are then closed with sutures. Eventually, the distended fibrous capsule will shrink and will be relined by urethral tissue.

As with TURP, about 90 percent of suprapubic prostatectomies are performed under spinal anesthesia, and the remainder under general anesthesia. Following the procedure, a urethral catheter is inserted to drain urine until the bladder regains muscle tone, and a suprapubic catheter is usually inserted into the bladder through the abdominal wall to flush blood from the bladder. Because the procedure involves open rather than endoscopic surgery, the average length of stay is much longer for suprapubic prostatectomy (9.4 days, vs. 4-5 days for TURP). The longer post-operative recovery period and the discomfort from abdominal surgical wounds undoubtedly account in part for the decline in popularity of this form of prostatectomy.

12.6 Complications

Minor complications which may occur with both forms of prostatectomy include post-operative bleeding, urinary tract infection, obstruction of the urethra by blood clots, and failure to void normally because of poor bladder tone. Treatment of these complications is usually routine.

Post-operative *urethral stricture* (narrowing) is a late complication of prostatic surgery, developing up to six months after surgery. In TURP patients, it is undoubtedly related to mechanical forces generated within the urethra by the resectoscope. It also occurs following suprapubic prostatectomy, perhaps because of the longer post-operative use of a urethral catheter. The incidence of this complication depends on how it is defined and diagnosed; clinically detectable narrowing of the urethra may occur in perhaps 20 percent of patients, but symptomatic strictures requiring urethral dilation occur in a far smaller number of cases. In a study of Manitoba data, Roos and Ramsey estimated the incidence of significant stricture as 4 percent following TURP, and 7 percent following suprapubic prostatectomy.

A related complication is *bladder neck contracture*. The bladder neck is a circular band of muscle fibers at the point where the urethra joins the bladder. During a TURP, muscle fibers of the bladder neck are frequently cut in an attempt to remove as much glandular tissue as possible. Following surgery, the cut muscle fibers may form a circular scar, which contracts as it heals, narrowing the bladder outlet.

Regardless of the surgical approach, nearly all patients experience *retrograde ejaculation* postoperatively. Because of anatomical changes in the prostate, semen is ejaculated into the bladder and is later voided with urine. Such men are sterile, but this is usually not of concern in the age group at risk for prostatectomy. Impotence is another significant complication of prostatectomy. It may occur with any surgical approach. It is difficult to obtain accurate data on the incidence of impotence following prostatectomy; published estimates have ranged from 4 to 40 percent, but are probably closer to 5 percent. Erectile potency depends on the complex interaction of nerves, arteries, veins, and muscles, as well as psychological and hormonal factors. Nerves and blood vessels may be accidentally cut during open prostatectomy, or may be damaged by heat during TURP. Finally, many men experience anxiety or depression following genitourinary surgery. Evaluation of post-surgical impotence requires months of follow-up together with a combination of psychological counseling, invasive and non-invasive testing, and perhaps medical or surgical treatment.

A small percentage of men undergoing prostatectomy for BPH will require repeat prostatectomy. In Roos' study of Manitoba data, prostatectomy was repeated within two

years for 4.5 percent of patients with TURPs, but only 0.8 percent with suprapubic prostatectomies. By eight years, the incidence of repeat prostatectomy exceeds 15 percent for TURP patients and 7 percent for patients with initial open prostatectomies. Since TURP entails the endoscopic removal of the prostate in small pieces, some prostatic tissue is inevitable left behind. Because this residual tissue remains under hormonal control, the process of benign prostatic hypertrophy continues and bladder outlet obstruction may recur, requiring repeat surgery in some cases. In suprapubic prostatectomy, removal of glandular tissue is more likely to be complete, and BPH is less likely to recur.

Finally, peri-operative death must be discussed as a complication of prostatectomy. Patients undergoing prostatectomy are nearly exclusively older men and have a high prevalence of heart disease. Peri-operative deaths are therefore often related to cardiovascular events, precipitated by side-effects of anesthesia, the stress of surgery, or the effects of fluid administration during surgery. The latter is particularly important during TURP procedures. When extensive amounts of prostatic tissue are removed transurethraally, large veins in the peripheral prostate may be cut and exposed. Substantial amounts of irrigation fluid can be absorbed rapidly through these veins. If large enough, such fluid absorption can cause a variety of symptoms and signs (referred to collectively as the "TURP syndrome") such as nausea, vomiting, visual disturbance, slowing of the heart rate, hypertension or hypotension, delayed recovery from anesthesia, mental confusion, coma, and even death. Fortunately, although some amount of irrigation fluid is absorbed in all TURPs, the TURP syndrome occurs in less than 1 percent of cases. Its risk can be minimized by reducing the pressure of the irrigating solution, avoiding lengthy surgical sessions, and terminating the procedure when large veins are exposed. (The syndrome does not occur in suprapubic procedures because the amount of irrigating fluid is insignificant.)

Mortality rates within 90 days of surgery appear to be comparable between TURP and suprapubic prostatectomies. Mortality is higher in older patients, in patients with pre-existing renal impairment, and when surgery is performed in small hospitals (< 150 beds).

12.7 Changes in Technology Affecting Risk/Benefit Ratio

Technologically, the procedures for both TURP and suprapubic prostatectomy have been relatively stable over the past decade. There have been minor improvements in the optical components of resectoscopes, allowing a wider field of vision. However, no procedure-related technological changes have occurred which would significantly alter the risk/benefit ratios associated with these two forms of prostatectomy.

A few surgical treatments have been developed as alternatives to prostatectomy. These include balloon dilation of the intraprostatic urethra, and placement of intra-urethral stents (small springlike devices which uncoil after insertion to maintain urethral patency). However, enthusiasm for balloon dilation is already waning, while stent placement has not been sufficiently tested to allow assessment of its value. Other untested technologies include laser ablation of the prostate, and intra-urethral use of hyperthermia to cause gradual sloughing of prostatic tissue.

Within the past few years, however, a medical innovation has appeared as a competing technology, and has markedly reduced the number of patients seeking surgery purely for relief of symptoms (rather than for treatment of severe obstruction). As mentioned above, some medications have the side effect of reducing muscle tone in the bladder and prostate. Two such agents (prazosin and terazosin) are approved by the FDA for the treatment of hypertension, but have been used successfully by many urologists to treat the symptoms of BPH. Since most of the symptoms of BPH occur from prostatic compression of the urethra, and from increased muscle tone and spasm in the hypertrophied bladder wall, medications which reduce muscle tone even slightly may sufficiently alleviate symptoms so that surgery can be avoided. In this respect, medical treatment can be seen as increasing the relative risk/benefit ratio of prostatectomy, since similar benefits can be achieved without the risks of surgery. Terazosin has the advantage of requiring only once-a-day dosage, and has proved to be popular with patients. Since such medical therapy is new, it is unknown how long patients may expect to obtain symptomatic relief from such medications. Since BPH is a progressive disease, it is likely that many who opt for medical therapy will ultimately require surgical treatment. In the meantime, however, these medications (particularly terazosin) have significantly reduced utilization of prostatectomy.

12.8 Changes in Indications for Prostatectomy

The indications for simple prostatectomy are relatively circumscribed: it is used only for the treatment of BPH. These indications have not changed. However, there may be a trend among urologists to perform prostatectomy earlier in the course of BPH, before permanent anatomic changes related to bladder outlet obstruction (such as thickening of the bladder wall) can occur.

12.9 Shifts of Procedures to Ambulatory Settings

A few urologists have performed TURPS in day-surgery settings. However, the results have been unpopular with both patients and physicians. Without frequent nursing care, urinary catheters are likely to become blocked by blood clots, resulting in painfully distended bladders, urgent calls to urologists, and visits to emergency rooms.

Suprapubic prostatectomies are not performed in ambulatory settings because of the use of low abdominal incisions.

12.10 Development of Clinical Guidelines for Prostatectomy

In January 1988, the American Urological Association (AUA) adopted a policy statement regarding TURP. The statement recognized each of the following conditions as a valid indication for TURP:

- urinary retention due to prostatic obstruction;
- intractable symptoms due to prostatic obstruction;
- recurrent or persistent urinary tract infection related to prostatic obstruction;
- recurrent gross hematuria caused by prostatic enlargement.

In addition, acceptable indications for TURP exist in patients with two or more of the following conditions:

- documented post-voiding residual urine [incomplete emptying of bladder];
- pathophysiologic changes of the kidneys, ureters or bladder caused by prostatic obstruction;
- abnormally low urinary flow rate;
- normal flow rate but with abnormally high intravesical [within the bladder] voiding pressure secondary to prostatic bladder obstruction.

These guidelines reflected the existing "common sense" standards of practicing urologists, and are unlikely to have had any effect on utilization of TURPs.

The AUA expects to release its first comprehensive policy statement regarding the treatment of BPH by the end of 1991. This guideline will discuss all surgical approaches, including suprapubic prostatectomy.

12.11 Summary

Both TURP and suprapubic prostatectomy are technologically stable procedures with unchanging indications. Neither procedure is performed routinely in ambulatory settings, and guidelines released in 1988 are unlikely to have affected utilization. However, the introduction within the past few years of medical therapy to reduce the symptoms of BPH is likely to cause a dramatic decrease in the number of prostatectomies performed, at least in the short run. It is possible that the popularity of medical therapy may decline with greater experience, and it is very likely that medical therapy merely postpones surgery for the majority of men with BPH.

REFERENCES

- American Urological Association. Policy Statement on Indications for Transurethral Prostatectomy. Baltimore, 1988.
- Burhenne HJ, Chisholm RJ, Quenville NF. Prostatic hyperplasia: radiologic intervention. Radiology 152:655-657 (September 1984).
- Castaneda F, Reddy P, Wasserman N, et al. Benign prostatic hypertrophy: retrograde transurethral dilation of the prostatic urethra in humans. Radiology 163:649-653 (June 1987).
- Fowler FJ, Wennberg JE, Timothy RP, Barry MJ, Mulley AG, Hanley D. Symptom status and quality of life following prostatectomy. JAMA 259(20):3018-3022 (May 27, 1988).
- Glenn JF. The male genital system, in DC Sabiston [ed.], Textbook of Surgery: The Biological Basis of Modern Surgical Practice. Philadelphia: W.B. Saunders, 1977.
- Hofer DR, Schaeffer AJ. Use of antimicrobials for patients undergoing prostatectomy. Urologic Clinics of North America 17(3):595-600 (August 1990).
- Holtgrewe HL, Mebust WK, Dowd JB, Cockett ATK, Peters PC, Proctor C. Transurethral prostatectomy: practice aspects of the dominant operation in American urology. Journal of Urology 141:248-253 (February 1989).
- Kadow C, Feneley RCL, Abrams PH. Prostatectomy or conservative management in the treatment of benign prostatic hypertrophy? British Journal of Urology 61:432-434 (1988).
- Lepor H. Nonoperative management of benign prostatic hyperplasia. Journal of Urology 141:1283-1289 (June 1989).
- Lue TF. Impotence after prostatectomy. Urologic Clinics of North America 17(3):613-620 (August 1990).
- Mebust WK. Transurethral prostatectomy. Urologic Clinics of North America 17(3):575-585 (August 1990).
- Mebust WK. Surgical management of benign prostatic obstruction. Urology (suppl.) 32(6):12-15 (December 1988).
- Mebust WK, Holtgrewe HL, Cockett ATK, Peters PC, and writing committee. Transurethral prostatectomy: immediate and postoperative complications. A cooperative study of 13 participating institutions evaluating 3,885 patients. Journal of Urology 141:243-247 (February 1989).
- Nielsen KK, Nordling J. Urethral stricture following transurethral prostatectomy. Urology 35(1):18-24 (January 1990).
- Paulsen D. Clinical Symposia: Diseases of the Prostate. Summit, N.J.: CIBA-Geigy Corporation, 1989.
- Rao PN. Fluid absorption during urological endoscopy. British Journal of Urology 60:93-99 (1987).
- Roos NP, Ramsey EW. A population-based study of prostatectomy: outcomes associated with differing surgical approaches. Journal of Urology 137:1184-1188 (June 1987).

REFERENCES (continued)

Roos NP, Wennberg JE, Malenka DJ, Fisher ES, McPherson K, Andersen TF, Cohen MM, Ramsey E. Mortality and reoperation after open and transurethral resection of the prostate for benign prostatic hyperplasia. New England Journal of Medicine 320(17):1120-1124 (April 27, 1989).

Wennberg JE, Mulley AG, Hanely D, Timothy RP, Fowler FJ, Roos NP, Barry MJ, McPherson K, Greenberg ER, Soule D, Bubolz T, Fisher E, Malenka D. An assessment of prostatectomy for benign urinary tract obstruction: geographical variations and the evaluation of medical care outcomes. JAMA 259(20):3027-3030 (May 27, 1988).

Wennberg JE, Roos N, Sola L, Schori A, Jaffe R. Use of claims data systems to evaluate health care outcomes: mortality and reoperation following prostatectomy. JAMA 257(7):933-936 (February 20, 1987).



13.0 UPPER GI ENDOSCOPY

13.1 Relevant Anatomy and Pathology

The upper GI tract includes the *esophagus*, the *stomach*, and the *duodenum* (the first segment of the small intestine). The esophagus is a muscular tube which propels food from the throat to the stomach. The process of digestion, which begins when salivary enzymes are mixed with food during chewing, is continued in the stomach by mechanical mixing and the addition of gastric enzymes (pepsin), and in the duodenum by pancreatic enzymes (amylase, lipase, and protease). All three organs contain a muscular layer, and an inner lining of mucous-secreting tissue called a mucous membrane. Most common disorders of the GI tract arise in mucous membranes.

Common diseases of the esophagus include:

- inflammation due to gastric or intestinal contents flowing back into the esophagus;
- infections, primarily from viruses and yeasts in immunosuppressed patients;
- swallowing disorders from damage to esophageal muscle or nerves;
- bleeding disorders, related commonly to tears in esophageal tissue after vomiting, or to *varices*, which are abnormally enlarged hemorrhoid-like veins seen usually in alcoholic liver disease;
- primary cancer of the esophagus.

Common disorders in the stomach and duodenum include inflammation and peptic ulcer disease. *Gastritis* (inflammation of the stomach) may be caused by medications, alcohol, or stress associated with severe illness or injury. *Peptic ulcers* (deep erosions of the mucous membrane) occur in both the duodenum and the stomach. Various factors, including increased acid secretion, the presence of certain bacteria, and certain medications, increase the risk of peptic ulcer. Peptic ulcers occurring in the stomach must be distinguished from *primary gastric carcinoma*, which can also have an ulcerated appearance on X-ray or endoscopy. However, since primary cancer of the duodenum occurs very infrequently, ulcers occurring in the duodenum are always considered to be benign. All three of these conditions (gastritis, peptic ulcers, and gastric carcinoma) can be the cause of upper GI bleeding.

13.2 Description of Procedure

Upper gastrointestinal (UGI) endoscopy is used to visually examine the tissues lining the upper gastrointestinal tract. Frequently, the procedure is referred to by a more specific name which indicates the portion of the GI tract examined: e.g., *esophagoscopy* (esophagus alone), or *esophagogastrroduodenoscopy* (esophagus, stomach, and duodenum).

The endoscope is a long tube containing flexible glass fibers (fiberoptics) which transmit light. One end of the endoscope is passed through the mouth and throat to the area to be examined (esophagus, stomach, or duodenum). The other end of the scope is connected to a light source. The light travels down the glass fibers to the tissue being examined, and an image of the illuminated area is transmitted back up the fibers to the viewing head, which is an eyepiece similar to that on a telescope. The endoscopist performing the procedure has a small circular field of vision, the contents of which change rapidly as the scope is advanced, withdrawn, or moved laterally within the GI tract. The tip of the endoscope can be flexed in any direction to help negotiate turns and to look at lesions head-on. In addition to fiberoptics, the endoscopic tube contains channels for suctioning of blood and other fluids, and for obtaining tissue samples by means of brushes or biopsy forceps.

UGI endoscopy is usually performed with both local anesthesia (to eliminate the sensations of touch and pain in the throat) and with intravenous sedation (to alleviate anxiety and restlessness during the procedure). The patient is conscious throughout the procedure, which lasts about 15 to 30 minutes. At least one assistant (typically a nurse) is usually present. Patients must prepare for the procedure by fasting overnight. Although the endoscope may create local discomfort and even gagging when passed through the throat, complications of the procedure are very infrequent. Major complications include bleeding and perforation. Some patients may become oversedated from intravenous medication, with transient respiratory depression. Rarely, patients experience a significant drop in heart rate and blood pressure as a result of reflexes stimulated by the endoscope. These complications, although very rare, can be fatal; therefore, UGI endoscopy is usually performed in

ambulatory settings within hospitals (endoscopy suites), instead of in physicians' offices, so that adequate support services are available for those patients who do experience respiratory or cardiovascular complications. Since the late 1980s, monitoring of blood pressure, blood oxygen levels, and heart rhythm has become common during UGI endoscopy, so that respiratory and cardiovascular problems can be detected as quickly as possible.

13.3 Indications for Upper GI Endoscopy

The most frequent use for UGI endoscopy is in the evaluation of *dyspepsia*. Dyspepsia refers to a vague complex of symptoms that includes pain or discomfort in the upper abdomen, accompanied by burning, bloating, belching, nausea, and/or other symptoms. The differential diagnosis in patients with these symptoms includes gastric ulcer, duodenal ulcer, and gastric cancer. When none of these more serious conditions is found, the symptom complex described above is labelled "dyspepsia." UGI endoscopy is used in the evaluation of dyspepsia to rule out more serious disease by visual inspection of the lower esophagus, stomach, and duodenum, with biopsy of any lesions that may be malignant. (An "upper GI series" of X-rays can also be used to detect ulcers and gastric cancer, but is a less sensitive and less specific test.)

Most gastroenterologists do not endoscope patients at the first appearance of dyspepsia, but will rather begin a course of antacids or other medications. Even symptoms caused by ulcers are usually relieved within a week of beginning such medical therapy. Endoscopy for dyspepsia is usually reserved for patients with unrelenting or recurring symptoms, or patients who appear to be severely ill. In these instances, the possibility of gastric cancer looms higher, and visualization and biopsy by endoscopy becomes more important.

Endoscopy is also used in the evaluation and treatment of upper GI bleeding. The most frequent causes of bleeding are ulcers, gastritis, varices, and small tears in the esophagus which may occur after vomiting. In cases of active bleeding, UGI endoscopy offers an advantage over X-ray studies: not only can the precise source of bleeding frequently be

visualized, but control of bleeding can often be achieved through endoscopic techniques such as cauterization (closing off bleeding vessels with heat or electric current).

UGI endoscopy is nearly always indicated in the evaluation of esophagitis, esophageal masses, swallowing disorders, and other esophageal disease, both for diagnosis (visualization and biopsy) and therapy (dilation of narrowed areas, debulking of tumors).

13.4 Changes in Technology Affecting Risk/Benefit Ratio

In the mid- to late-1980s, several improvements in endoscopic technology made the procedure more tolerable for patients. First, endoscopes with smaller diameters became available, making the procedure more comfortable for patients. Although the use of local anesthetics reduces or eliminates the sensations of touch and pain in the throat, patients are still able to feel pressure when a larger-diameter endoscope pressed against the back of the throat. Smaller endoscopes are also easier to maneuver from the stomach into the narrower duodenum.

A second change that may have affected the risk/benefit ratio is the use of video technology. Video endoscopes have been available since about 1984; a second generation of videoscopes with improved quality became available around 1988. With a videoscope, the area under examination is displayed on a video screen instead of through an eyepiece. The image is larger and can be viewed by several observers at the same time; it can also be videotaped. The greatest advantage of videoscopes is the ability to document and communicate endoscopic findings more completely and accurately: clinical teaching is more effective, and videotaped procedures can be replayed to review pathologic findings and endoscopic therapeutic maneuvers. For these reasons, videoscopes have become essential in teaching hospitals, and may well have resulted in improved quality of endoscopic diagnosis and treatment in such facilities. However, the high cost of videoscopes (about ten times that of standard scopes) has limited their diffusion in non-teaching settings.

Third, changes in anesthesia have altered the risk/benefit ratio somewhat. In 1986 a new intravenous sedative became available which increased patient tolerance of the procedure. The new drug, Versed, is similar to Valium and can be used intravenously

with a rapid onset of action. It can be used alone or with a narcotic such as Demerol to sedate patients and reduce anxiety during brief procedures such as endoscopy. However, it has a shorter half-life than Valium. Patients recover more rapidly from its effects and can be discharged from ambulatory surgical facilities more quickly and without lingering sedation. Versed has the additional advantage of causing amnesia for the procedure in the majority of patients: although they remain conscious during the endoscopy, they later do not recall the procedure or any associated discomfort.

Finally, improvements in technology have expanded the therapeutic benefits of upper GI endoscopy. Active bleeding in the upper GI tract (usually from ulcers or esophageal varices) can be controlled by electrical cauterization or coagulation with a heat probe or laser. Esophageal varices (those hemorrhoid-like veins that are prone to bleeding) can be treated endoscopically by injecting them with chemical agents which cause inflammation and eventual fibrosis of the vein; this process is called *sclerotherapy* and has been available since about 1980. In a newer endoscopic treatment for varices, available only since about 1988, rubber bands are placed around the base of the varices, eliminating their blood supply. This procedure (*ligation of varices*) may be just as effective and have fewer complications than sclerotherapy: the needles used in sclerotherapy can sometimes puncture the esophageal wall, with injection of highly irritating chemicals into the midline structures of the chest.

Therapeutic upper GI endoscopy is also used in the palliative treatment (affording relief, but not cure) of esophageal cancer, either by debulking the tumor with a laser or by placing a stiff tube through the narrowed cancerous area, to allow passage of soft foods and liquids.

In patients who are unable to swallow because of debilitating conditions such as stroke or Parkinson's disease, feeding may be accomplished through a gastrostomy tube placed into the stomach through the abdominal wall. Until the early 1980s, initial gastrostomy tube placement was performed under general anesthesia. A technique has been developed, however, in which these tubes can be inserted using an endoscope and local anesthesia. Endoscopic placement of gastrostomy tubes has now become routine, and can be performed in five to ten minutes, eliminating the risk of general anesthesia.

13.5 Changes in Indications for Upper GI Endoscopy

The principal uses of diagnostic endoscopy are the evaluation of dyspepsia; examination of mucosal membrane lesions of the esophagus, stomach, and duodenum; investigation of active bleeding in these areas; and assessment of abnormal narrowing or dilation of the esophagus caused by nervous or muscular disorders. These indications have not changed since the introduction of the procedure.

As discussed above, the role of upper GI endoscopy as a therapeutic procedure has expanded greatly. However, therapeutic procedures (whether for control of bleeding, treatment of esophageal narrowing, or placement of gastrostomy tubes) account for a small proportion of upper GI endoscopy; most upper endoscopy is performed for diagnostic purposes.

13.6 Shift to Ambulatory Settings

Upper GI endoscopy has been considered an ambulatory procedure for many years, and no patient is admitted simply for endoscopy. However, patients may be endoscoped in inpatient settings when admission is required for medical or surgical reasons (for example, active GI bleeding; severe dehydration and/or malnutrition, perhaps from GI disease; related or unrelated major surgical procedure).

Although upper GI endoscopy has long been an ambulatory procedure, it has remained by and large hospital-based: it is usually performed in endoscopy suites located physically within a hospital, so that support staff are available if complications occur. (When necessary, the procedure may also be performed in an intensive care unit or emergency room.) There are instances, however, in which groups of gastroenterologists have set up office-based endoscopy suites, free-standing facilities in which adequate support staff are available if needed. Third-party reimbursement regulations may discourage office-based procedures, however, if no facility charge is allowed to compensate for the overhead of maintaining stand-by support services.

13.7 Development of Clinical Guidelines for Upper GI Endoscopy

In 1985, the Health and Public Policy Committee of the American College of Physicians (ACP) published a position paper on the role of upper GI endoscopy in the evaluation of dyspepsia. Citing statistics that only 20 percent of patients with dyspepsia have ulcers and less than one percent have gastric cancer, the guidelines recommended that endoscopy not be performed in the initial evaluation of dyspepsia, but be reserved for those patients who:

- have symptoms despite 6 to 8 weeks of appropriate anti-ulcer medical therapy (cessation of alcohol, tobacco, and ulcerogenic medications such as aspirin; institution of anti-ulcer medications such as antacids or histamine blockers);
- have no response after 7 to 10 days of anti-ulcer therapy;
- have complications of ulcer disease (e.g., bleeding);
- show signs of severe systemic illness (e.g., significant weight loss); or
- have recurrence of symptoms during or following completion of therapy.

These guidelines reflected common beliefs regarding the use of endoscopy in 1985 when they were published, and so they are unlikely to have had much impact on utilization. However, dyspepsia is a relatively common symptom complex, and inappropriate endoscopic evaluation of dyspeptic symptoms represents an area in which significant overutilization of endoscopy may be occurring. Brook *et al.*, using 1981 medical records data for 1058 Medicare patients who had undergone upper GI endoscopy in five states, found that 17 percent of these endoscopies represented inappropriate overuse, and that the use of the procedure was equivocal in another 11 percent of cases. Endoscopies were more likely to be appropriate if performed in a teaching hospital, but less likely to be appropriate if performed by a board-certified gastroenterologist. No estimates of overutilization during the late 1980s are available. However, the impact of the ACP's guidelines on overutilization may have been limited since they were not enforced by medical professional organizations or by third-party payors.

In 1988 the American Society for Gastrointestinal Endoscopy (ASGE) published a number of guidelines related to upper GI endoscopy, covering such issues as the role of

endoscopy in the management of upper GI bleeding, and the role of endoscopy in the management of peptic ulcer disease. All of these guidelines were brief (1 or 2 pages), and again reflected common practice.

Many medical journals carry advertisements for short training courses in endoscopic procedures. These courses typically last a few days to a week, and involve classroom instruction and the use of artificial models, rather than actual supervised experience with patients. Guidelines published by the ACP in 1987 and the ASGE in 1988 indicate that such courses do not provide sufficient preparation to perform upper GI endoscopy, and that hospitals should not grant privileges to physicians whose endoscopic training is limited to these courses. The 1987 ACP training guidelines require a minimum of 50 supervised procedures (with patients, not artificial models) for certification of clinical competence.

The concern addressed by these training guidelines is that physicians with inadequate training may be purchasing endoscopes and performing these procedures. However, the impact of these guidelines on the quality of training is uncertain. Supervised endoscopic experience has been part of gastroenterology training programs for at least a decade, and nearly all recent graduates of such programs would meet or exceed published guidelines for clinical competence in endoscopy. Many older gastroenterologists have completed approved endoscopic training courses to gain clinical competence. Since most upper GI endoscopy has been performed in hospital endoscopy suites rather than in physicians' offices, hospital restrictions on privileges would reduce the possibility of poorly qualified physicians performing endoscopy. It is likely that a few physicians (particularly surgeons, who are procedure-oriented and have access to operating rooms) have begun performing upper GI endoscopy without completion of approved training. However, even with the availability of short (and inadequate) endoscopic training courses, it is extremely unlikely that increased utilization of upper GI endoscopy is attributable to diffusion of the procedure to a large number of medical and surgical generalists.

13.8 Summary

Upper GI endoscopy is a useful tool in the diagnosis and therapy of a variety of disorders of the esophagus, stomach, and duodenum. The greatest technological

changes in the late 1980s have been involved therapeutic uses of endoscopy to control bleeding, treat varices, dilate narrowed areas of the esophagus, and insert gastrostomy tubes. However, these therapeutic uses account for a small part of the utilization of upper GI endoscopy. Changes in overall utilization rates for the procedure would have been influenced heavily by the use of diagnostic endoscopy. Although the indications for diagnostic endoscopy have not changed, the number of gastroenterologists has grown substantially (by 22 percent between 1985 and 1989, according to AMA data), and a change in supply may perhaps have had the greatest influence on utilization. In addition, patients and referring physicians are more aware of endoscopy as a diagnostic tool; increased demand for a definitive diagnostic procedure (and fear of loss of referrals) may cause gastroenterologists to perform endoscopy earlier in the course of symptoms than suggested by clinical guidelines, thus contributing to growth in utilization rates for endoscopy.

REFERENCES

- American College of Physicians. Clinical competence in diagnostic esophagogastroduodenoscopy. Annals of Internal Medicine 107(6):937-939 (December 1987).
- American College of Physicians. Endoscopic sclerotherapy for esophageal varices. Annals of Internal Medicine 100(4):608-610 (April 1984).
- American College of Physicians. Endoscopy in the evaluation of dyspepsia. Annals of Internal Medicine 102(2):266-269 (February 1985).
- American Society for Gastrointestinal Endoscopy. Guidelines for establishment of gastrointestinal endoscopy areas. Gastrointestinal Endoscopy 34(3, suppl.):3S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of upper gastrointestinal hemorrhage. Gastrointestinal Endoscopy 34(3, suppl.):4S-5S (1988).
- American Society for Gastrointestinal Endoscopy. Standards of practice of gastrointestinal endoscopy. Gastrointestinal Endoscopy 34(3, suppl.):8S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of esophagitis. Gastrointestinal Endoscopy 34(3, suppl.):9S (1988).
- American Society for Gastrointestinal Endoscopy. Statement on role of short courses in endoscopic training. Gastrointestinal Endoscopy 34(3, suppl.):14S-15S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the surveillance of premalignant conditions of the upper gastrointestinal tract: guidelines for clinical application. Gastrointestinal Endoscopy 34(3, suppl.):18S-20S (1988).
- American Society for Gastrointestinal Endoscopy. The role of endoscopy in the management of the patient with peptic ulcer disease. Gastrointestinal Endoscopy 34(3, suppl.):12S-13S (1988).
- Brook RH, Park RE, Chassin MR, Solomon DH, Keesey J, Kosekoff J. Predicting the appropriate use of carotid endarterectomy, upper gastrointestinal endoscopy, and coronary angiography. New England Journal of Medicine 323(17):1173-1177 (October 25, 1990).
- Chua KL. Recent advances in upper gastrointestinal endoscopy. Annals of the Academy of Medicine of Singapore 12(4):535-538 (October 1983).
- Coleman WH. Gastroscopy: a primary diagnostic procedure. Primary Care 15(1):1-11 (March 1988).
- Van Steigman G. Endoscopic ligation of esophageal varices. American Journal of Surgery 156(2):9B-12B (September 1988).

14.0 CHANGES IN VOLUME OF OVERPRICED PROCEDURES

14.1 Introduction

This chapter examines changes in the number of "overpriced" procedures over the 1985-1989 study period. The major emphasis lies on the volume trends themselves and testing for statistical significance. In addition, however, we examine shifts in procedure code mix, the mix of specialties performing the procedure, and in the location of service. Accompanying the overpriced procedure reductions were limits on balance billing by nonparticipating physicians. In order to examine potential OBRA impacts on out-of-pocket payments, we also examine trends in assignment rates and beneficiary liability. Finally, this chapter compares changes in the use of assistant surgeons for the overpriced procedures.

For easier reading, we have chosen to place the voluminous number of tables and figures at the end of this chapter, following the text. The graphs (Figures 14-1 through 14-13) are interspersed with the tables, so that all exhibits are in the order they are referenced in the text.

14.2 Methods

14.2.1 Study Design

This part of the project sought to measure volume changes resulting from the overpriced procedure reductions. Measurement is complicated, however, by the absence of a true control group, as well as concurrent changes in other factors that may influence both physicians and patients. It would thus be difficult to know whether any observed changes are an explicit physician response or simply a secular time trend.

We developed a quasi-experimental study design that attempted to control for at least some of the competing explanations for observed volume trends. This design took advantage of the natural geographic variation in the fee reductions and drew on a longer time-series (as opposed to a simple before-after, 1987-88 design). Our design was a cross-section/time-series based on calendar years 1985-1989 inclusive. The great advantage to this time period is that it

provided us with extensive data points before the overpriced procedure reductions: two full years before the OBRA-86 cuts and just over three years prior to OBRA-87.

Unlike most fee freezes or fee reductions which are applied across the board, the OBRA-87 reductions were designed to reduce fees disproportionately more in areas where fee levels were relatively high. As a result, the independent variable of policy interest (the payment reduction) varied widely around the country. Some areas experienced relatively large reductions (limited by law to no more than 15%), some incurred relatively minor reductions, and some areas were totally unaffected by the cuts. This variation provided us with nonequivalent control groups that could be used to assess the impact of the OBRA reductions.

14.2.2 Data Sources

Our analysis relied on the Multistate Data Base constructed by CHER under HCFA cooperative agreements. This data base included 100 percent Part B claims data from eleven states: Alabama, Arizona, Connecticut, Georgia, Kansas (including that portion of the Kansas City MSA in Missouri), New Jersey, Oklahoma, Oregon, Pennsylvania, Washington, and the District of Columbia (including those parts of the D.C. MSA in Maryland and Virginia). Claims data were available for calendar years 1985 through 1989.

While a national sample of Medicare claims would have been preferable, the only available national data bases at the time were the BMAD five percent samples. These samples were simply too small to permit analysis at the reasonable charge locality level. For this reason, we opted for the Multistate Data Base which contains a census of all procedures performed in those states. These eleven states combined represent one-quarter of the U.S. Medicare population. Furthermore, as will be seen below, these states exhibited considerable range in the independent variable of interest: the size of the payment reduction.

14.2.3 File Construction

All claims involving overpriced procedures were abstracted from the Multistate Data Base. These included not only the CPT-4 codes identified by OBRA-87, but several other

closely related procedure codes. The complete list of codes is shown in Table 14-1. Over the five year study period, there have been considerable additions, deletions, and revisions to the CPT-4 manual. Failure to take these into consideration could seriously bias the results. Consider bronchoscopy and total hip replacement, for example. Three CPT-4 bronchoscopy codes were targeted for payment reductions, based on the 1988 coding manual. However, prior to 1988, three different codes had been used for billing purposes. Similarly, in the case of hip replacements, four new codes have been added since 1988, and the definition of the old codes has been changed. Failure to take these changes into account would have resulted in an apparent increase in bronchoscopies since OBRA-87, and an apparent decrease in hip replacements.

We abstracted all claims for these procedure codes with a designated type of service code of "surgery" or "assistant surgery". This was necessary for two reasons. First, there is considerable variability in how assistant surgeons are billed; in some areas, they appear explicitly as assistant surgeons, while in others, they appear as co-surgeons. We identified as assistant surgeons any claims with type of service equal to assistant surgery or any second bill for the same operation for the same patient on the same day. While modifiers exist to identify second or co-surgeons, they are rarely used. Failure to identify such co-surgeons could have caused an overestimate of the true volume of procedures performed in any one time period. Second, the use of assistant and co-surgeons was of interest in its own right. The increased use of "helpers" during the operation was one hypothesized response to the payment reductions.

Twelve analytic files were created, one for each of the twelve groups of overpriced procedures. For each file, the unit of observation was defined by the following data elements: calendar quarter (1-20), state and reasonable charge locality, procedure code and modifier, specialty, and location of service. Virtually all analyses in this chapter were based on primary surgeon bills only, with analysis of assistant surgeons conducted separately (see Section 14.8 below). When more than one surgical bill was found for the same patient on the same day (within a given procedure group), the record with the highest allowed charge was assumed to be the primary surgeon. The other records were classified as assistant surgeons.

14.2.4 Calculation of Payment Change

The primary objective of our analysis was to determine whether volume changes varied systematically with the size of the payment change. This required construction of a "payment change" variable for each of the twelve procedure groups.

The payment change was defined as the change in the average allowed charge for a procedure group from 1987 to 1988.* (For cataract procedures, the payment change was based on 1986 to 1988 reductions, incorporating both OBRA-86 and OBRA-87.) Because the OBRA-87 reductions actually went into effect in April 1988, we calculated the reductions based on only the last three quarters of 1987 and 1988. All variables were defined at the state-reasonable charge locality level.

Ideally, the payment change would have been defined at the individual procedure code level. We decided against this, because of the very small number of claims for some procedure codes in some localities and the resulting instability in our payment change measure. Instead, we calculated an overall payment change for each group of overpriced procedures. A weighted average allowed charge was constructed for both 1987 and 1988, where the weights were based on the national distribution of procedure codes within each group. This weighting was used to adjust for any changes in procedure code mix over time. The payment change was then calculated as the simple percentage change from 1987 to 1988.

As can be seen from Table 14-2, there was wide variation in the size of the payment reduction across localities within each of the twelve procedure groups. Many of the groups included some localities with the maximum reduction of 15 percent as well as some localities that actually received MEI updates (i.e. the payment change measure was positive, indicating increased allowed charges). Nevertheless, it should be noted that the average payment reductions were exceedingly small, only a few percentage points at most.

*An alternative definition of payment change could have incorporated the change in balance billing, as OBRA-87 also placed special balance billing limits on nonparticipating physicians. We chose to limit our measure to changes in allowed charges only because of the imprecision of balance billing amounts calculated from claims data. We do not have individual MAACs, for example. Anecdotal evidence suggests, furthermore, that some physicians may not actively pursue balance bill amounts. Finally, it is not clear that the OBRA-87 balance billing restrictions were actually enforced by the carriers.

Although the OBRA-87 reductions were limited by statute to no more than 15 percent, all three New Jersey localities experienced considerably larger reductions for CABG surgery: 18-37 percent. This was due to an unrelated change in prevailing charge determination made by the New Jersey carrier in 1988.

Reasonable charge localities were categorized into three groups based on the size of their payment change:

- large reduction (payment reductions of 5% or more);
- small reduction (payment reductions less than 5%); and
- no change or an actual increase in the average allowed charge.

Table 14-3 displays the number of reasonable charge localities (RCLs) in each of these three groups. Our eleven states include a total of 49 localities. Some procedure groups include fewer than this number, if no procedures were performed within a locality. More sophisticated operations, like bypass surgery and joint replacements, for example, were not provided in rural localities.

14.3 Trends in Volume

All volume trends were expressed as means per RCL (or group of RCLs). Totals by state and year can be found in the appendix. RCLs vary considerably by size; some represent collections of counties, while others constitute a single county. In order to adjust for this, we weighted each RCL by its number of Medicare residents.

14.3.1 Tabular Trends by Quarter

Tables 14-4 through 14-15 display quarterly trends in the mean number of procedures for the three groups of localities: large reduction, small reduction, and no change or increase. At the end of each calendar year is the average number per quarter for that year and,

beginning with 1986, the percent change in volume over the prior calendar year.* Figures 14-1 through 14-12 present the same data graphically.

Tabular results for total hip replacement are shown in Table 14-4 and Figure 14-1. There was a definite slowing of volume over time in all areas, with a marked reduction in volume in 1989 for the "large reduction" areas. There is no evidence that these volume reductions were associated with the payment reductions, as rates of volume growth first began to slow in 1987. Furthermore, the volume levels are much higher in both groups of RCLs experiencing payment reductions, compared with the "no change/increase" group. This suggests that utilization may be slowing (or even declining), as surgeons exhaust the number of available patients. Joint replacement surgery can be considered a "one-time" procedure during this study period, at least for any one joint. While hip (and knee) prostheses may eventually loosen and require replacement, their expected duration is generally greater than five years.

Volume trends also begin to slow markedly for total knee replacements in 1989, especially in the large reduction areas (see Table 14-5 and Figure 14-2). Note, however, the very disparate levels of use across the three groups of localities. Average knee replacement volume was 7-8 times higher in the large reduction areas, and 3-4 times higher in the small reduction areas, compared with the no change or increase group.

After increasing rapidly from 1985 to 1987, the rate of knee arthroscopy growth slowed considerably in 1988 (Table 14-6 and Figure 14-3). Although coincident with the payment reductions in April, this deceleration appeared short-lived; the rate of utilization growth increased in 1989 across all three groups of areas.

Bronchoscopy volume has been flat or declining throughout the 1985-89 study period (Table 14-7 and Figure 14-4). There are no discernible patterns by size of payment reduction. It should be recalled from Table 14-2 that the actual payment changes were especially small for bronchoscopy (an average of 0.8%).

*Because the payment reduction did not go into effect until April 1988, we also calculated annual percent changes in volume based on the last three quarters of each calendar year. These percent changes were not appreciably different (in direction or magnitude) from those based on the full calendar year. For ease of presentation, we chose to display only percent changes based on the full calendar year, as these are more readily understood.

Rates of growth for pacemaker insertion have been relatively slow, or even declining (Table 14-8 and Figure 14-5). In 1986, HCFA mandated PRO review of every pacemaker procedure for medical necessity; as a result, physicians may have become increasingly selective in their performance of this procedure. This explanation would be consistent with the much larger decline in volume observed for the areas experiencing large payment reductions, which are also the areas with the highest initial levels of use.

The volume of CABG surgery has increased steadily across all three groups of areas (Table 14-9 and Figure 14-6). A jump of 20 percent from 1988-1989 in the large reduction areas (compared with 10% elsewhere) is somewhat noteworthy. While this may be suggestive of a positive volume response by surgeons, the reader is cautioned that, unlike other procedures in which the large reduction group represents many states, the CABG large reduction group is disproportionately made up of New Jersey localities. Only seven RCLs received CABG payment reductions of 5 percent or more, and three of these were located in New Jersey. Thus, observed volume trends for this group may reflect factors specific to that state, rather than the OBRA-87 cuts per se.

Utilization of upper GI endoscopy grew steadily over the study period, with no apparent patterns associated with the size of the payment reduction (Table 14-10 and Figure 14-7). Again, however, the average payment reduction was relatively small for this procedure, with only five RCLs experiencing cuts of 5 percent or more (recall Tables 14-2 and 14-3).

The volume of transurethral and suprapubic prostatectomies declined steadily over the five-year period (Tables 14-11 and 14-12, and Figure 14-8 and 14-9, respectively). These declines may have been the result of Wennberg's studies of surgery versus "watchful waiting" for patients with benign prostatic hypertrophy. There were no discernible pattern in trends by the size of the payment change. Because the absolute number of suprapubic prostatectomies was so small, we do not show this procedure in any subsequent tables.

The use of dilation and curettage (D & C) of the uterus among Medicare patients appears to have stabilized in 1987, with a marked decline in 1989 (Table 14-13 and Figure 14-10). Interestingly, there was almost no change in volume from 1987 to 1989 among the large reduction areas, while the small reduction and no change/increase areas showed a

dramatic drop in volume. Historically, however, the large reduction areas had considerably lower levels of D and C use, compared with the small reduction areas.

The volume of carpal tunnel release surgery grew steadily, although the 1988-89 rate of increase was well below that of the prior two years (Table 14-14 and Figure 14-11). There were no obvious patterns by size of payment change. Although rates of growth were consistently higher in the no change/increase group, this probably reflects their lower baseline utilization levels.

The volume of cataract surgery across our eleven states clearly stabilized after 1987 (Table 14-15 and Figure 14-12). This may be largely due to increased market saturation; ophthalmologists have probably exhausted the backlog of demand that existed when improved intra-ocular lenses became widely available in the early 1980s.

Unlike the other procedure groups, cataract surgery was subject to two payment reductions, first in January 1986 and again in April 1988. There do not appear to be any changes in volume that can be readily associated with the payment reductions. Cataract volume increased modestly (6.6%) among large reduction areas, not at all among small reduction areas, and jumped by one-fifth in the no change/increase areas. More consistent volume patterns appeared in 1988-89. Cataract volume remained flat in large reduction areas, with a modest increase in small reduction areas, and slightly larger growth in no change/increase areas (looking at the net change from 1987 to 1989). These results might suggest that ophthalmologists responded by cutting back on cataract surgery when payments were reduced. However, a more plausible explanation is market saturation; levels of use were much greater in the large reduction areas compared with the other two areas.

14.3.2 Testing the Volume Trends for Statistical Significance

For most of the overpriced procedures, there appeared to be no systematic relationship between volume trends and the size of the payment change. In a few cases (notably hip and knee replacements and cataract surgery), the tabular data suggest that rates of growth actually slowed in areas with relatively larger payment reductions. These trends are difficult to interpret, however, as volume levels were much higher in areas experiencing payment reductions, compared with the "no change/increase" group. The correlation of volume

with payment change category makes trend comparisons particularly difficult. Many of the overpriced procedures are "one-time," or non-recurring operations, at least during this short five-year period.* This means that high-volume areas will be unable to sustain high growth rates indefinitely, as the market becomes saturated and surgeons exhaust the available patient pool.

Thus, in order to determine whether any statistically significant changes in volume resulted from the OBRA payment reductions, we must control for initial levels of use, as well as secular time trends.** Time-series analysis was used to do this, using the following equation:

$$\text{PROCS} = \sum_i \alpha_i \text{PAY}\Delta + \sum_i \beta_i \text{PAY}\Delta \cdot \text{QTR}_q + \sum_i \rho_i \text{OBRA} \cdot \text{PAY}\Delta_i \cdot \text{QTR}_q$$

where

PROCS = number of procedures per RCL-quarter;

PAY Δ = L,S,N (representing the large reduction, small reduction, and no change/increase areas, respectively);

OBRA = 1 for QTR > 13, zero otherwise;

QTR $_q$ = 1,2,...20.

The RCL-quarter was the unit of observation, with 680 to 980 observations, depending on the procedure group. PAY Δ was specified as two dummy variables, one each for large and small payment change localities, respectively. (The no change/increase localities constituted the omitted category.)

Figure 14-13 provides a graphical representation of what we expected to learn from this regression. The L, S, and N lines depict hypothetical intercept and time trends for the large reduction (L), small reduction (S), and no change/increase groups (N), respectively. The alpha coefficients associated with the PAY Δ variable are interpreted as the intercepts

*Of course, to the extent individuals have two knees, hips, and eyes, they may receive two operations. While this expands the initial pool upon which surgeons may draw, trends would be unaffected.

**Ideally, of course, one would develop an econometric model to test for these effects, while controlling for area demand and supply characteristics. Unfortunately, the project work scope was limited to non-econometric methods.

associated with the three groups, or the baseline volume levels. The beta coefficients associated with the QTR*PAYΔ variables represent the slopes of the L, S, and N lines, or the rates of volume growth for the three groups of areas. Finally, the rho coefficients associated with the OBRA*PAYΔ*QTR variables provide the actual test of volume changes associated with the OBRA payment changes. Specifically, these coefficients represent deviations around the slopes of the three lines. A statistically significant positive rho coefficient associated with large reduction areas would indicate a sharp break in the slope of the L line at the point at which L intersects the dotted line on Figure 14-13 and, hence, evidence of a positive volume response to fee reductions.

This regression was estimated for each set of overpriced procedures separately. Because we were not estimating a behavioral model, we had no prior expectations about positive versus negative changes. Instead, we sought simply to test whether to accept or reject the null hypothesis of no volume change associated with payment reduction. We were unable to reject this hypothesis; there was no evidence that volume changed (in any direction) as a result of OBRA-87. The rho coefficients were uniformly insignificant for all of the overpriced procedures.

Our analyses did confirm the importance of controlling for initial volume levels. The alpha coefficients were significant and positive for all but two of the eleven procedure groups (arthroscopy and TURP), that is, initial volume levels were significantly higher in areas experiencing payment reductions, compared with no change/increase areas.

While we found no evidence of behavioral response (either positive or negative), caution should be exercised in generalizing these results to volume changes under the Medicare Fee Schedule. First of all, the average payment reductions enacted under OBRA-87 were far smaller than those anticipated under the MFS. Second, with a maximum of 49 RCLs and with substantial inter-area variation in surgical volumes (even within payment change category), we may simply have lacked the statistical power to detect any effects.

14.4 Trends in Procedure Code Mix

Many of our overpriced procedure groups include a mix of codes reflecting differences in the exact operation performed. Trends in procedure code mix are largely due to technology

diffusion, as equipment or techniques become more widely available. It is possible, however, that physicians may seek to "upcode" the procedures performed in order to qualify for higher reimbursement. If so, then trends toward a more complicated procedure mix should be particularly pronounced in the "large reduction" areas.

Tables 14-16 through 14-22 display annual trends in procedure code mix for our three groups of RCLs and for all areas. (Excluded are TURP, carpal tunnel release, and D and C, as these groups consist of single codes. Also excluded is bronchoscopy, where the coding changes made it difficult to categorize procedures reliably.) Table 14-16 shows a clear trend away from hip conversion and toward revisions. These trends are consistent with changes in technology, and we observe no discernible patterns by size of payment change. Conversions represent operations in which prior hip arthroplasty is followed by a complete replacement. These have declined in relative frequency, as surgeons choose total hip replacement to start with, rather than less-than-total arthroplasty. Revisions, on the other hand, represent a "re-do" of prior hip replacement. These have become more common, as earlier replacements "loosen", especially those earlier replacements provided before the better acrylic glues came on the market.

A similar increase in the relative number of revisions can be seen for knee replacement surgery (Table 14-17), as earlier knee prostheses also loosen. While revisions represent a slightly smaller percent of procedures in the no change/increase group, this undoubtedly reflects the slower diffusion of knee replacement technology to these areas in the first place. (Recall that procedure volume was considerably lower for this group.)

The most common form of knee arthroscopy includes meniscectomy, the removal of loose pieces of meniscus, or cartilage, from around the knee (see Table 14-18). Over the five year study period, reflecting technology improvements, there has been a modest growth in the number of arthroscopies including actual repair of the meniscus. These latter procedures are still relatively infrequent, however, and no discernible patterns in their use can be seen by size of payment reduction.

Trends in procedure code mix for permanent pacemaker insertions clearly reflect technology diffusion. There has been a shift away from the simpler atrial pacemakers towards the ventricular, and more sophisticated AV-sequential, pacemakers (Table 14-19). There were no real differences across the three groups of RCLs.

Over time, cardiac surgeons appear to have moved away from bypass operations involving a single graft, as well as those operations involving six or more grafts (see Table 14-20). Trends in procedure code mix were generally similar for both the large and small reduction areas. The no change/increase areas reported a disproportionate number of operations with six or more grafts. Beginning in 1988, however, this fell abruptly to two percent, a proportion consistent with all other areas. The reasons for this are unclear, but may reflect geographic practice patterns; this group included a disproportionate number of Kansas and Oregon RCLs.

There has been a small, but definite, trend toward conducting biopsies during upper GI endoscopy (Table 14-21). A relatively larger number of endoscopies in the large reduction areas include biopsies; this more complicated procedure code mix can be observed during every year, however, and does not appear related to the OBRA-87 cuts.

Finally, the vast majority of cataract operations involved the one-stage procedure (extraction plus IOL insertion), and the number increased steadily over the 1985-1989 period (Table 14-22). There were no discernible differences by size of payment change.

14.5 Trends in Specialty Mix

Most of the overpriced procedures are performed by a single surgical specialty, but the two endoscopic procedures (bronchoscopy and upper GI endoscopy) are performed by both medical and surgical specialists. The OBRA-87 cuts could affect specialty mix, if more expensive physicians were more likely to reduce the number of endoscopies they performed.

The trend, however, is toward concentration of endoscopies among the most specialized, and presumably more expensive, physicians. Pulmonary disease specialists steadily supplanted internists and other specialists in the performance of bronchoscopy (Table 14-23), while gastroenterologists increasingly replaced internists and general surgeons in the performance of GI endoscopy (Table 14-24). The most striking difference across groups of areas was the much lower prevalence of medical specialists in the no change/increase group; internists and "others" (largely GPs and FPs) were more common providers of both endoscopic procedures in these areas. This is consistent with the small urban and rural nature of many of the RCLs in the no change/increase group.

14.6 Trends in Location of Service

Many of the overpriced procedures, like joint replacements and CABG surgery, can only be performed in the inpatient hospital setting, but others, particularly diagnostic procedures, can be performed almost anywhere. Tables 14-25 through 14-30 display time trends in the location of service for the six groups of procedures that are often done outside the hospital. Three possible locations are shown: physician's office, inpatient hospital, and hospital outpatient department (OPD) or ambulatory surgical center (ASC). All six procedures showed dramatic shifts in site of care to ambulatory settings.

There were no marked differences in location of care across the three groups after the implementation of the payment reductions. A relatively larger number of procedures were performed in the hospital in the large reduction areas. This is true for all six procedures and for all years, and undoubtedly reflects inter-state differences in practice patterns.

14.7 Trends in Assignment Rates and Beneficiary Liability

14.7.1 Assignment Rates

From the very beginning, the Medicare participating physician program has offered incentives for physicians to sign up and agree to accept all patients on assignment. As seen in Tables 14-31 through 14-41, assignment rates have skyrocketed for all of the overpriced procedure groups.* Unlike most statistics that report these rates as a percent of allowed charges, our data are based on the percent of procedures. Thus, based on Table 14-31 we see that 74 percent of total hip replacements performed in large reduction areas in 1989 were accepted on assignment, compared with only 64 percent of the hip replacements in no change/increase areas.

In order to test whether the OBRA-87 legislation helped to increase these assignment rates, regressions were estimated for each procedure group, using the same specification

*Unfortunately, data were not available on the participation status of Pennsylvania and D.C. physicians prior to 1989; for this reason, we were unable to show trends in participation rates.

described in Section 2.3.2 above except with assignment as the dependent variable. There was no evidence of any change in assignment (up or down) associated with the payment reductions and their accompanying balance billing restrictions. This is admittedly a weak test; participation rates would have been the more appropriate dependent variable, as these rates presumably would have been more sensitive to the OBRA changes.

14.7.2 Beneficiary Liability

The overpriced procedure reductions had the potential to lower beneficiary out-of-pocket liability in two ways. First, to the extent that allowed charges were reduced, the 20 percent copayment was reduced commensurately. Second, OBRA-87 placed special balance billing limits on overpriced procedures performed by nonparticipating physicians. We were interested in examining trends in beneficiary liability to determine the magnitude of potential savings for beneficiaries. Some analysts have argued that the OBRA-87 payment reductions may have stimulated the demand for these procedures, as net prices fell for patients. To the extent that beneficiaries have supplemental (Medi-Gap) policies, however, this effect will be attenuated.

Copayments were calculated simply as 20 percent of the allowed charge. Balance billing amounts prior to OBRA-87 were calculated as the difference between billed and allowed charges on non-assigned claims. Determining the post-OBRA balance bill amounts was less straightforward. OBRA limited actual charges for overpriced procedures to 125 percent of the reduced prevailing charge plus half of the amount by which the physician's MAAC exceeded this level during the previous year. Unfortunately, we did not have access to individual MAACs. Instead, we calculated the post-OBRA balance amount as the difference between 125 percent of the billed charge and the allowed charge itself, or the difference between the billed and allowed charge, whichever was lower. While imprecise, this should still provide us with an approximation of true reductions in balance bill amounts.

Tables 14-42 to 14-52 display trends in copayments and total liability amounts (copay plus balance bills) per procedure. Trends were similar across all procedure groups. Using Table 14-42 as an example, we observe a steady increase in copayments for total hip replacement until 1988. In 1988, copayments fell 5.6 percent in large reduction areas, and

1.8 percent in small reduction areas, while rising in areas that were not subject to the overpriced procedure reductions. In the subsequent year (1989), copayments rose in all areas, as allowed charges were updated for all procedures.

The reductions in total liability were far more dramatic, with a 19 percent drop in 1988 for patients in large payment reduction areas. Because the balance billing limits apply to all overpriced procedures by nonparticipating physicians, beneficiary savings can be achieved even in areas where payments were not reduced. (The particularly large reduction in total liability in no change/increase areas shown here reflects the low participation rate among surgeons in these areas.) While total liability generally began to grow again in 1989, the size of the increase was generally small, as participation rates also grew.

These reductions in out-of-pocket liability, especially balance billing liability, should be very encouraging to policymakers. They suggest that beneficiaries enjoyed increasing financial protection over this time period. Several caveats should be mentioned, however. First, our measure of balance billing liability is fairly crude and may overstate true reductions resulting from OBRA-87.* On the other hand, anecdotal evidence suggests that some physicians do not actively pursue all balance bill amounts. Second, recent media reports have cast doubt on the actual enforcement of these balance billing restrictions by the carriers. As a result, many patients may have continued to receive, and pay, balance bill amounts that were in excess of the OBRA-87 restrictions. The complicated nature of the balance billing limits and MAAC calculations have made it difficult for both carriers and physicians to determine the appropriate balance bill amounts.

14.8 Trends in Use of Assistant Surgeons

Tables 14-53 through 14-59 display changes in the use of assistant surgeons for those surgical groups that historically involve assistants with any frequency. The numbers shown in the table represent the ratio of assistant surgeons to procedures. In most instances, these ratios are less than one, as a single assistant, at most, is involved with the operation. In

*They will be overestimated to the extent that physicians have MAACs exceeding the reduced prevailing charge. Physicians were permitted to bill for one-half of this excess, an amount we were not able to include in our measure of balance billing liability.

some cases, however, multiple assistants may be involved; this explains why ratios may exceed one, as they sometimes do for CABG surgery (Table 14-57).

The use of assistant surgeons increased steadily from 1985 to 1989 for the three orthopedic procedures (hip and knee replacement, and knee arthroscopy), but there was no discernible pattern by payment change category (see Tables 14-53 through 14-55). It should be noted, however, that we can not reliably determine bilateral joint surgery from claims data. It is thus possible that some cases of apparent "co-surgery" (i.e. two surgeons' bills) actually represented operations on two different joints.

There is a marked decline in the use of assistant surgeons during pacemaker insertion, especially in those areas experiencing payment reductions (Table 14-56). We suspect that this reflects the introduction of universal case review by the PROs. Similarly, PRO review was probably largely responsible for the decline in assistants during cataract surgery (Table 14-59). Strictly speaking, we should not expect any assistants during these lens procedures. One explanation is bilateral eye surgery, although this is generally believed to be medically risky.

TABLE 14-1

CPT-4 CODE DEFINITIONS FOR STUDY OF OVERPRICED PROCEDURE REDUCTIONS

<u>Procedure Group</u>	<u>OBRA-87 Codes</u>	<u>Added Codes</u>
Total hip replacement	27130-27132	27134-27138
Total knee replacement	27446-27447	27486-27487
Knee arthroscopy	29881	29880, 29882-29883
Bronchoscopy	31622-31626	31620-31621, 31627
Pacemaker insertion	33206-33208	none
CABG surgery	33510-33528	none
Upper GI endoscopy	43235-43239	none
TURP	52601	none
Suprapubic prostatectomy	55821	none
D & C	58120	none
Carpal tunnel release	64721	none
Cataract extractions	66830-66985	none

Source: American Medical Association, CPT-4 coding manuals.

TABLE 14-2

PERCENT CHANGE IN MEAN RCL ALLOWED CHARGES, 1987-1988

<u>Procedure</u>	<u>Mean</u>	<u>Maximum Reduction</u>	<u>Maximum Increase</u>
Total Hip Replacement	-0.3%	-10.8%	13.4%
Total Knee Replacement	-2.1	-14.9	29.2
Knee Arthroscopy	-4.1	-14.4	3.2
Bronchoscopy	0.8	-12.5	30.1
Pacemaker Insertion	-1.4	-15.9	7.4
CABG Surgery ^a	-3.3	-36.5	16.6
Upper GI Endoscopy	-1.8	-10.5	11.2
TURP	-0.2	-6.2	4.5
Suprapubic Prostatectomy	3.5	-15.3	17.1
D & C	-1.6	-12.2	14.2
Carpal Tunnel Release	-2.9	-14.4	10.8
Cataract Surgery ^b	-5.3	-20.2	8.6

^aPayment reductions exceeded 15 percent in all New Jersey RCLs because of unrelated changes in reasonable charge determination made by the New Jersey carrier.

^bPercent change is based on 1986-1988 for cataract procedures.

Source: Part B claims from eleven states.

TABLE 14-3

NUMBER OF REASONABLE CHARGE LOCALITIES BY SIZE OF PAYMENT CHANGE CATEGORY^a

<u>Procedure</u>	<u>PAYMENT CHANGE</u>		
	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>
Hip Replacement	10	19	20
Knee Replacement	10	27	12
Knee Arthroscopy	15	20	13
Bronchoscopy	11	23	15
Pacemaker Insertion	5	24	20
CABG Surgery	7	14	13
GI Endoscopy	5	33	11
TURP	1	19	28
Suprapubic Prostatectomy	5	15	25
D & C	10	21	18
Carpal Tunnel Release	18	23	8
Cataract Surgery	27	9	11

^aLarge reductions were defined as payment reductions of at least 5 percent and small reductions those less than 5 percent.

Source: Medicare Part B claims from eleven states.

TABLE 14-4

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TOTAL HIP REPLACEMENT

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	170.2	172.3	70.9	140.1
2	177.7	190.0	73.4	150.7
3	163.2	177.5	74.3	141.9
4	179.4	180.3	63.6	143.6
Average	172.6	180.0	70.6	144.1
<u>1986</u>				
1	171.9	195.3	68.2	150.1
2	208.8	190.0	79.7	159.7
3	184.8	186.6	74.0	150.9
4	189.9	182.7	69.7	148.9
Average	188.8	188.7	72.9	152.4
Percent Change	9.4%	4.8%	3.3%	5.8%
<u>1987</u>				
1	185.5	191.8	79.5	155.1
2	210.8	203.7	80.1	166.4
3	176.1	179.1	79.2	147.1
4	184.0	205.6	78.8	160.9
Average	189.1	195.0	79.4	157.4
Percent Change	0.1%	3.4%	8.9%	3.3%
<u>1988</u>				
1	184.0	192.3	81.0	155.4
2	197.6	204.3	83.1	164.7
3	199.9	190.2	82.0	158.3
4	193.2	187.8	73.9	153.2
Average	193.7	193.7	80.0	157.9
Percent Change	2.4%	-0.7%	0.8%	0.3%
<u>1989</u>				
1	188.0	195.4	77.2	156.4
2	190.4	191.0	81.4	156.3
3	165.7	183.6	82.4	147.7
4	149.7	188.3	79.5	145.4
Average	173.4	189.6	80.1	151.4
Percent Change	-10.4%	-2.1%	0.1%	-4.1%

Source: Medicare Part B claims from eleven states.

Figure 14-1 Volume Trends for Total Hip Replacement

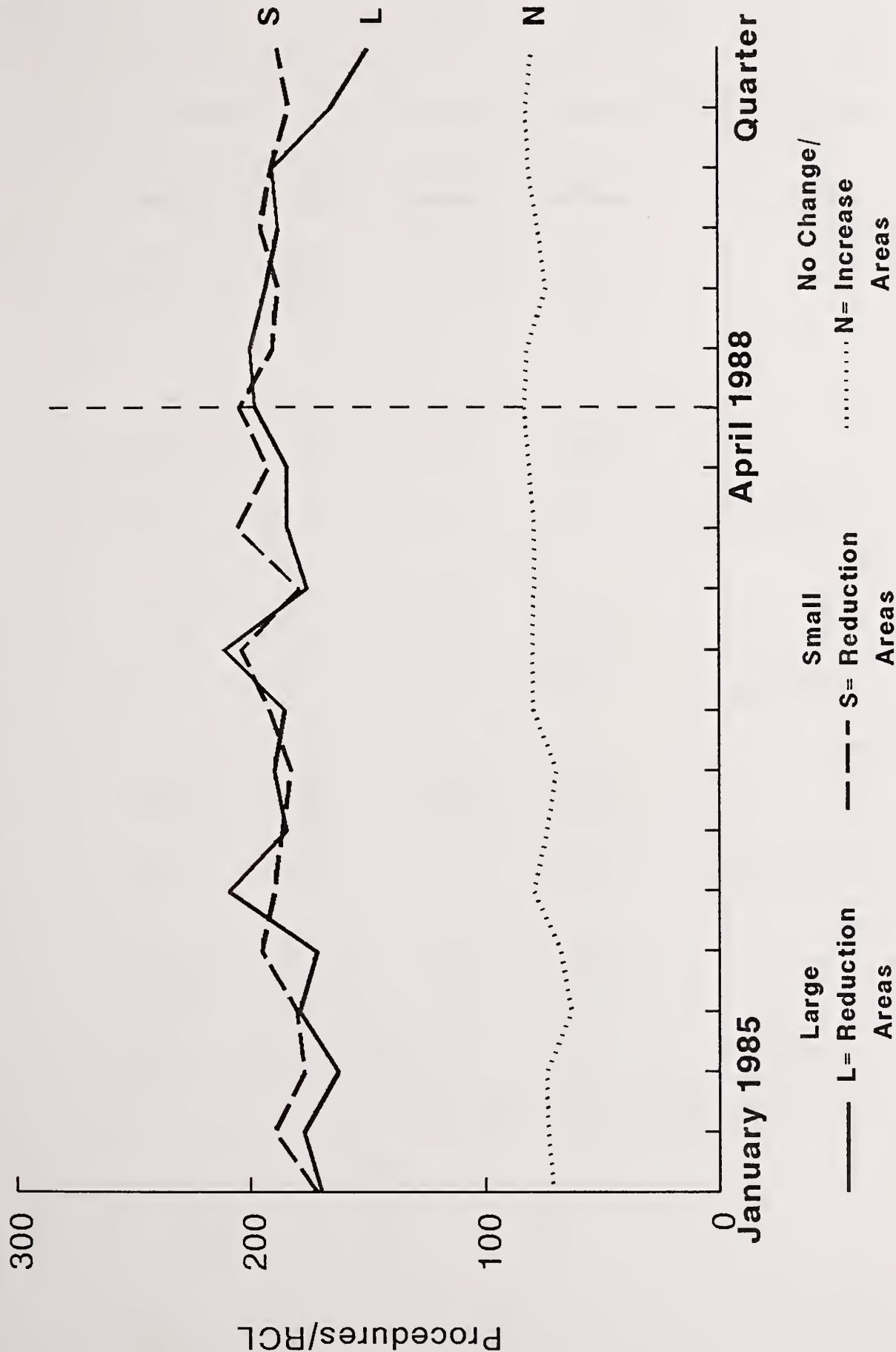


TABLE 14-5

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TOTAL KNEE REPLACEMENT

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	183.1	74.0	18.5	102.1
2	216.9	84.2	27.0	120.2
3	190.0	87.3	24.2	111.7
4	210.1	83.2	27.0	117.4
Average	200.0	82.2	24.2	112.9
<u>1986</u>				
1	211.0	84.1	24.8	117.3
2	235.6	98.0	27.7	132.9
3	236.3	94.0	23.5	130.5
4	230.1	96.6	29.2	130.6
Average	228.3	93.2	26.3	127.8
Percent Change	14.1%	13.4%	8.8%	13.2%
<u>1987</u>				
1	242.7	99.8	29.6	136.1
2	255.4	103.4	32.9	142.8
3	247.4	105.4	30.6	140.5
4	265.9	113.8	31.6	151.0
Average	252.8	105.6	31.2	142.6
Percent Change	10.8%	13.3%	18.5%	11.6%
<u>1988</u>				
1	262.6	117.6	35.8	152.0
2	315.9	122.6	36.7	172.8
3	297.8	123.5	32.4	166.2
4	277.2	124.6	36.0	160.4
Average	288.4	122.1	35.3	162.8
Percent Change	14.0%	15.6%	13.1%	14.2%
<u>1989</u>				
1	296.7	138.4	41.3	174.0
2	333.4	139.8	39.1	186.7
3	325.3	134.2	43.8	182.2
4	310.0	138.7	46.7	179.6
Average	316.3	137.8	42.7	180.6
Percent Change	9.7%	12.8%	21.2%	10.9%

Source: Medicare Part B claims from eleven states.

Figure 14-2

Volume Trends for Knee Replacement

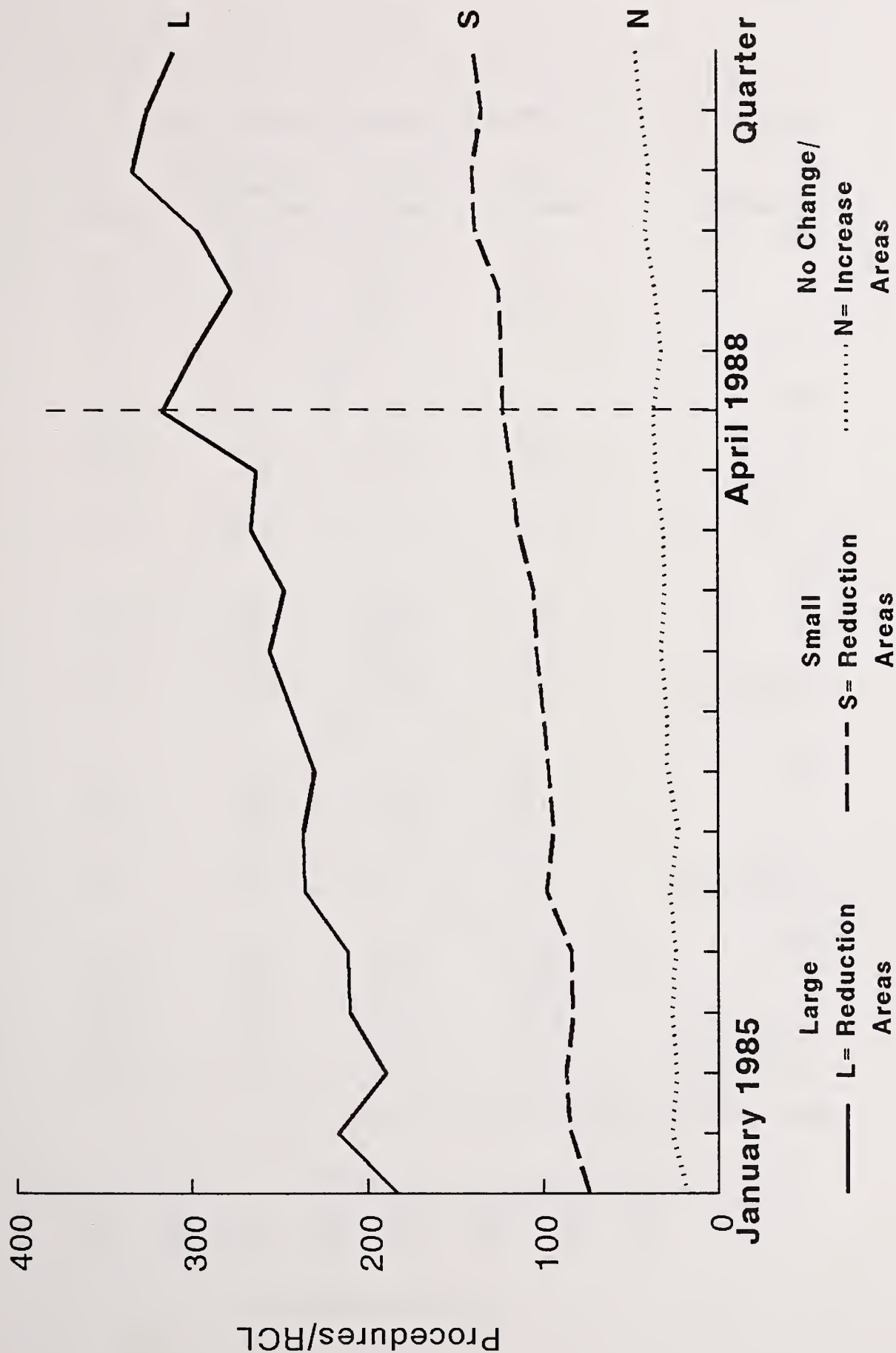


TABLE 14-6

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: KNEE
ARTHROSCOPY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	9.6	3.8	13.5	7.3
2	12.3	4.8	12.4	8.3
3	18.3	4.8	13.1	10.0
4	20.4	4.8	7.7	9.4
Average	15.1	4.6	11.7	8.8
<u>1986</u>				
1	27.7	10.2	14.9	15.7
2	35.9	53.0	27.9	43.3
3	29.8	50.2	29.7	40.6
4	30.9	53.3	21.9	41.0
Average	31.1	41.7	23.6	35.1
Percent Change	105.2%	813.7%	101.8%	301.4%
<u>1987</u>				
1	35.3	46.8	29.7	40.2
2	44.8	65.2	33.7	53.3
3	42.0	66.8	37.8	54.3
4	47.6	64.6	32.2	53.4
Average	42.4	60.9	33.4	50.3
Percent Change	36.6%	46.0%	41.5%	43.1%
<u>1988</u>				
1	45.0	54.5	29.8	46.8
2	50.6	63.1	34.6	53.8
3	47.6	66.0	40.9	55.9
4	42.1	60.8	40.9	51.7
Average	46.3	61.1	36.6	52.1
Percent Change	9.1%	0.4%	9.6%	3.5%
<u>1989</u>				
1	50.1	60.2	35.9	52.4
2	62.9	69.4	44.2	62.4
3	57.2	77.1	44.6	65.0
4	57.9	71.8	40.4	61.5
Average	57.0	69.6	41.3	60.3
Percent Change	23.1%	14.0%	13.0%	15.9%

Source: Medicare Part B claims from eleven states.

Figure 14-3

Volume Trends for Knee Arthroscopy

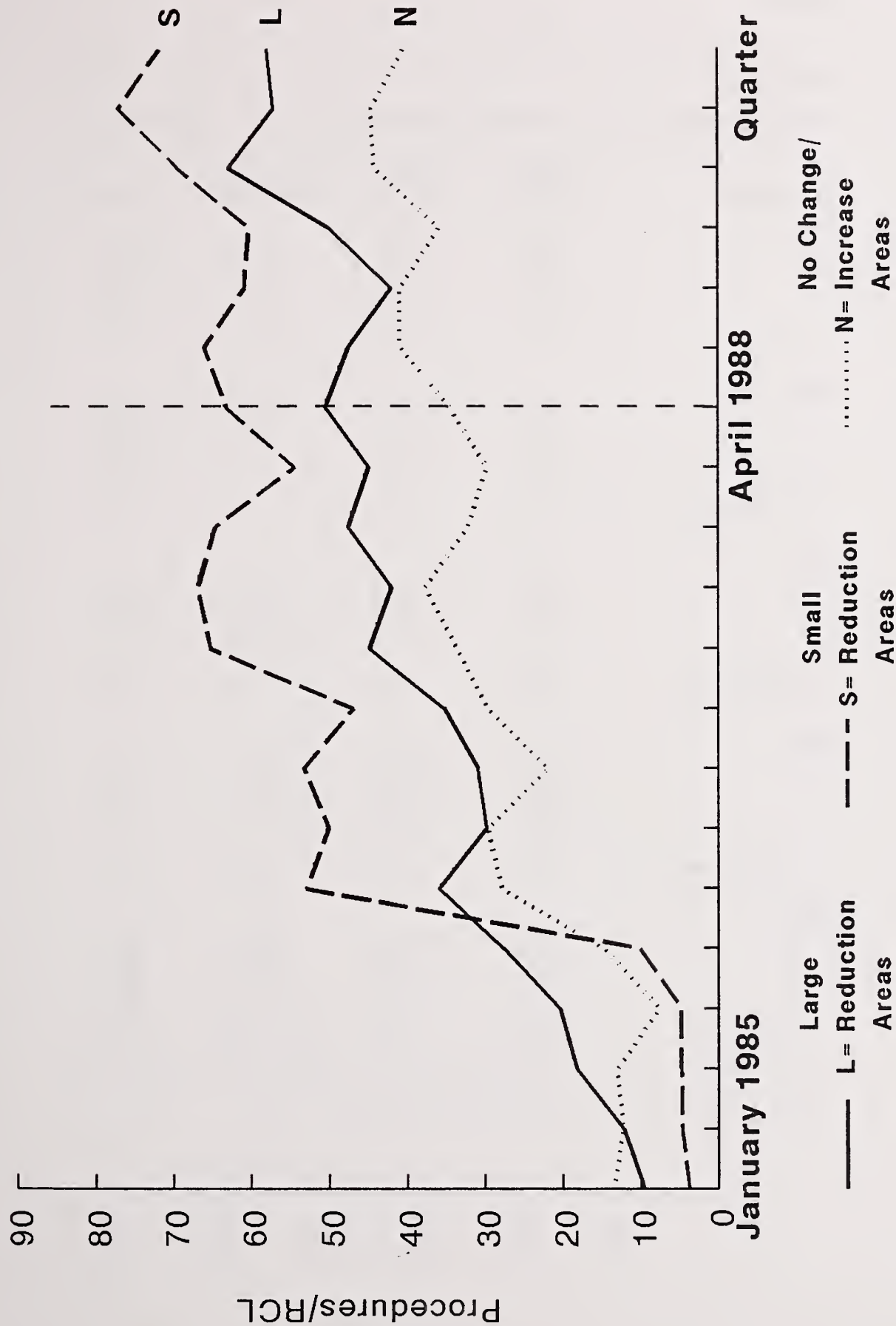


TABLE 14-7

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: BRONCHOSCOPY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	470.2	599.5	192.6	484.3
2	453.8	590.0	172.3	470.9
3	421.2	552.8	171.6	442.3
4	404.8	578.6	158.1	449.8
Average	437.5	580.2	173.7	461.8
<u>1986</u>				
1	454.0	579.1	190.3	468.2
2	448.5	573.8	201.0	466.2
3	406.3	537.0	177.4	430.8
4	419.9	534.1	181.1	433.3
Average	432.2	556.0	187.4	449.6
Percent Change	-1.2%	-4.2%	7.9%	-2.6%
<u>1987</u>				
1	409.3	597.8	187.5	466.9
2	408.7	571.8	195.9	454.2
3	381.0	559.2	184.8	438.2
4	384.6	536.3	170.2	423.5
Average	395.9	566.3	184.6	445.7
Percent Change	-8.4%	1.8%	-1.5%	-0.9%
<u>1988</u>				
1	416.8	557.7	190.6	447.0
2	390.3	541.9	183.2	430.3
3	360.7	512.3	175.7	405.3
4	350.0	532.2	167.9	412.1
Average	379.5	536.0	179.4	423.7
Percent Change	-4.2%	-5.3%	-2.8%	-4.9%
<u>1989</u>				
1	390.0	588.0	183.7	455.3
2	413.3	546.7	176.0	436.7
3	361.0	524.2	177.6	412.1
4	352.7	514.6	192.9	408.0
Average	379.3	543.4	182.5	428.0
Percent Change	-0.1%	1.4%	1.8%	1.0%

Source: Medicare Part B claims from eleven states.

Figure 14-4

Volume Trends for Bronchoscopy

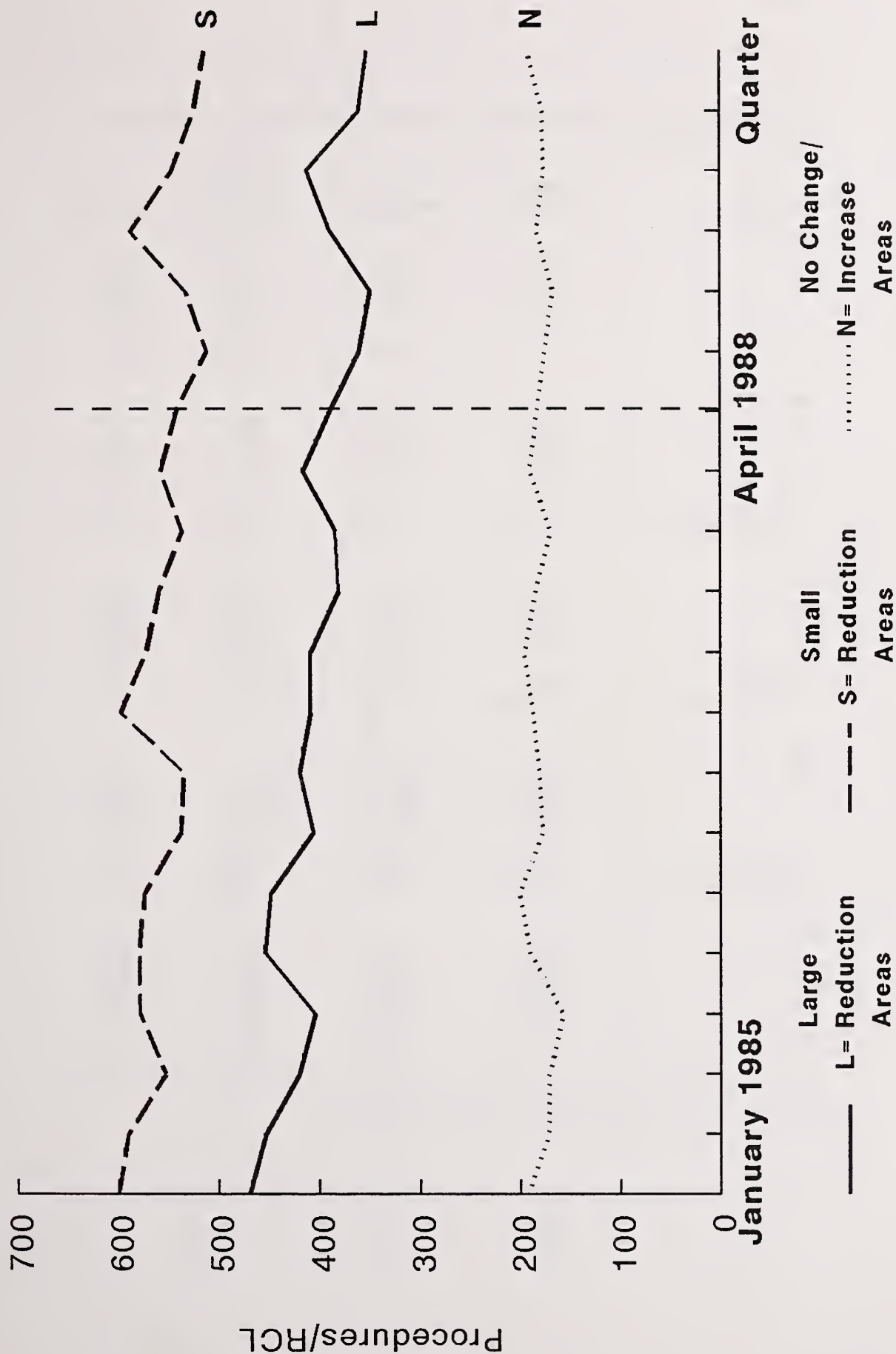


TABLE 14-8

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: PERMANENT
PACEMAKER INSERTION

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	254.0	191.2	54.3	162.8
2	293.1	195.0	55.8	170.7
3	262.0	196.5	57.3	167.8
4	270.6	198.1	47.7	167.3
Average	269.9	195.2	53.8	167.1
<u>1986</u>				
1	259.0	201.8	58.7	170.8
2	283.1	203.3	58.6	174.9
3	271.8	201.6	61.0	173.0
4	239.3	202.5	52.9	167.0
Average	263.3	202.3	57.8	171.4
Percent Change	-2.5%	3.6%	7.5%	2.6%
<u>1987</u>				
1	236.9	197.0	51.5	162.9
2	267.2	218.9	60.3	182.4
3	291.7	218.1	60.2	185.2
4	267.1	214.3	56.9	178.8
Average	265.7	212.1	57.2	177.3
Percent Change	0.9%	4.8%	-1.0%	3.4%
<u>1988</u>				
1	261.7	201.5	54.2	169.6
2	273.3	217.8	64.6	183.6
3	275.5	223.2	61.4	186.2
4	282.2	207.6	53.2	175.6
Average	273.2	212.5	58.4	178.8
Percent Change	2.8%	0.2%	2.0%	0.8%
<u>1989</u>				
1	282.7	214.0	59.8	181.1
2	290.3	218.6	63.8	186.0
3	234.6	209.1	55.8	170.8
4	198.7	214.6	59.5	170.3
Average	251.6	214.1	59.7	177.0
Percent Change	-7.9%	0.7%	2.3%	-1.0%

Source: Medicare Part B claims from eleven states.

Figure 14-5

Volume Trends for Pacemaker Insertion

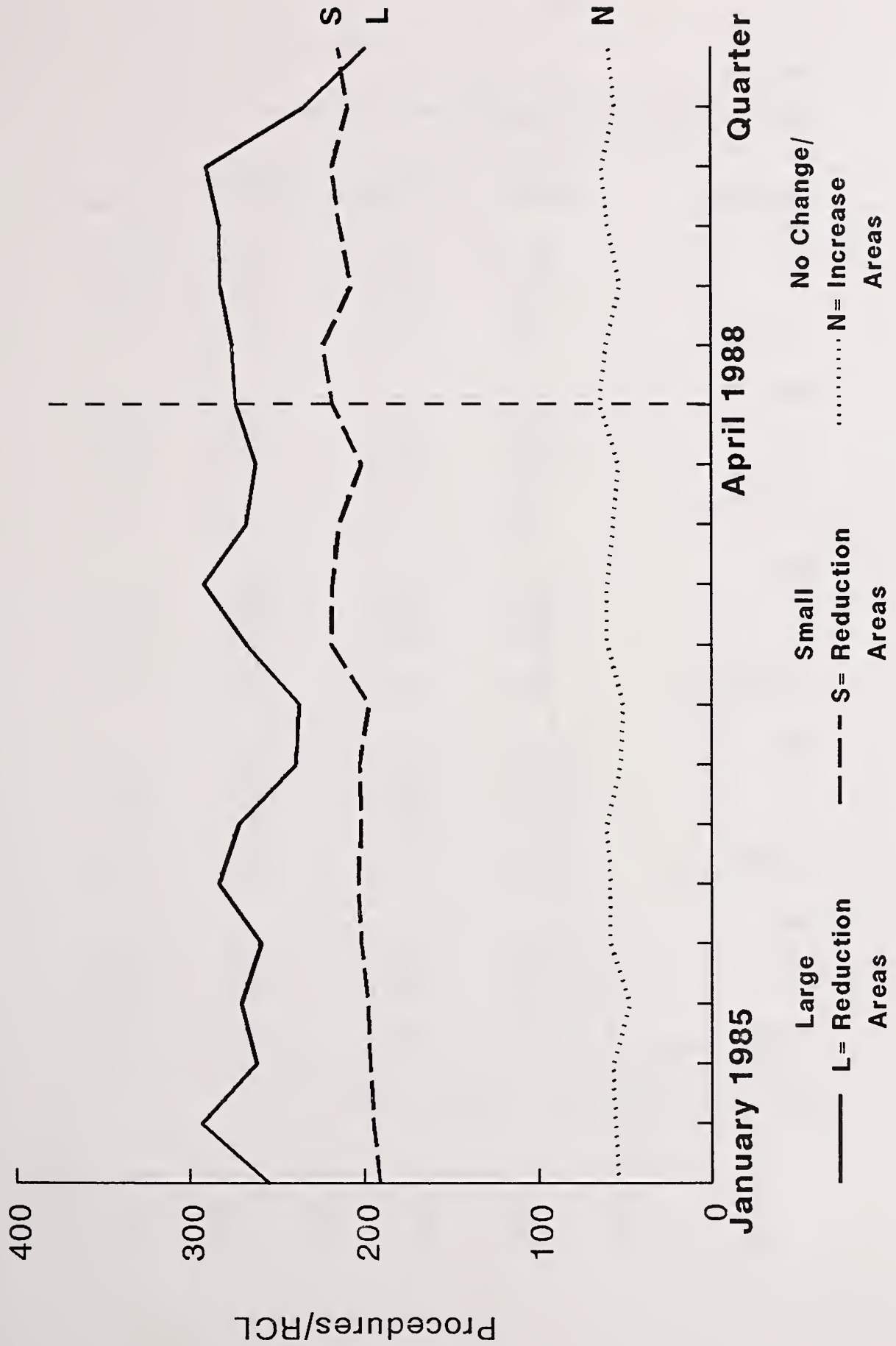


TABLE 14-9

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CORONARY
ARTERY BYPASS GRAFT (CABG) SURGERY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	69.7	337.9	107.0	203.2
2	97.8	348.3	93.9	214.2
3	107.2	346.1	106.9	218.9
4	112.7	356.6	94.0	222.8
Average	96.8	347.2	100.5	214.8
<u>1986</u>				
1	135.5	373.9	113.7	242.5
2	154.0	392.5	107.3	255.7
3	151.2	390.9	96.4	251.8
4	157.2	432.2	114.5	276.9
Average	149.5	397.4	108.0	256.7
Percent Change	54.4%	14.4%	7.5%	19.5%
<u>1987</u>				
1	168.8	448.3	117.0	288.7
2	176.8	464.2	120.8	299.5
3	164.8	461.8	106.5	291.5
4	184.2	501.9	113.2	317.9
Average	173.6	469.1	114.4	299.4
Percent Change	16.2%	18.0%	5.9%	16.6%
<u>1988</u>				
1	188.4	492.3	127.9	318.0
2	209.5	527.8	137.0	343.2
3	185.9	501.4	129.0	321.7
4	207.8	531.3	128.1	342.4
Average	197.9	513.2	130.5	331.3
Percent Change	14.0%	9.4%	14.1%	10.7%
<u>1989</u>				
1	249.7	575.4	134.3	377.6
2	260.9	582.2	150.7	387.9
3	222.8	547.3	145.0	358.3
4	218.9	552.4	143.4	359.2
Average	238.1	564.4	143.4	370.7
Percent Change	20.3%	10.0%	9.8%	11.9%

Source: Medicare Part B claims from eleven states.

Figure 14-6

Volume Trends for CABG Surgery

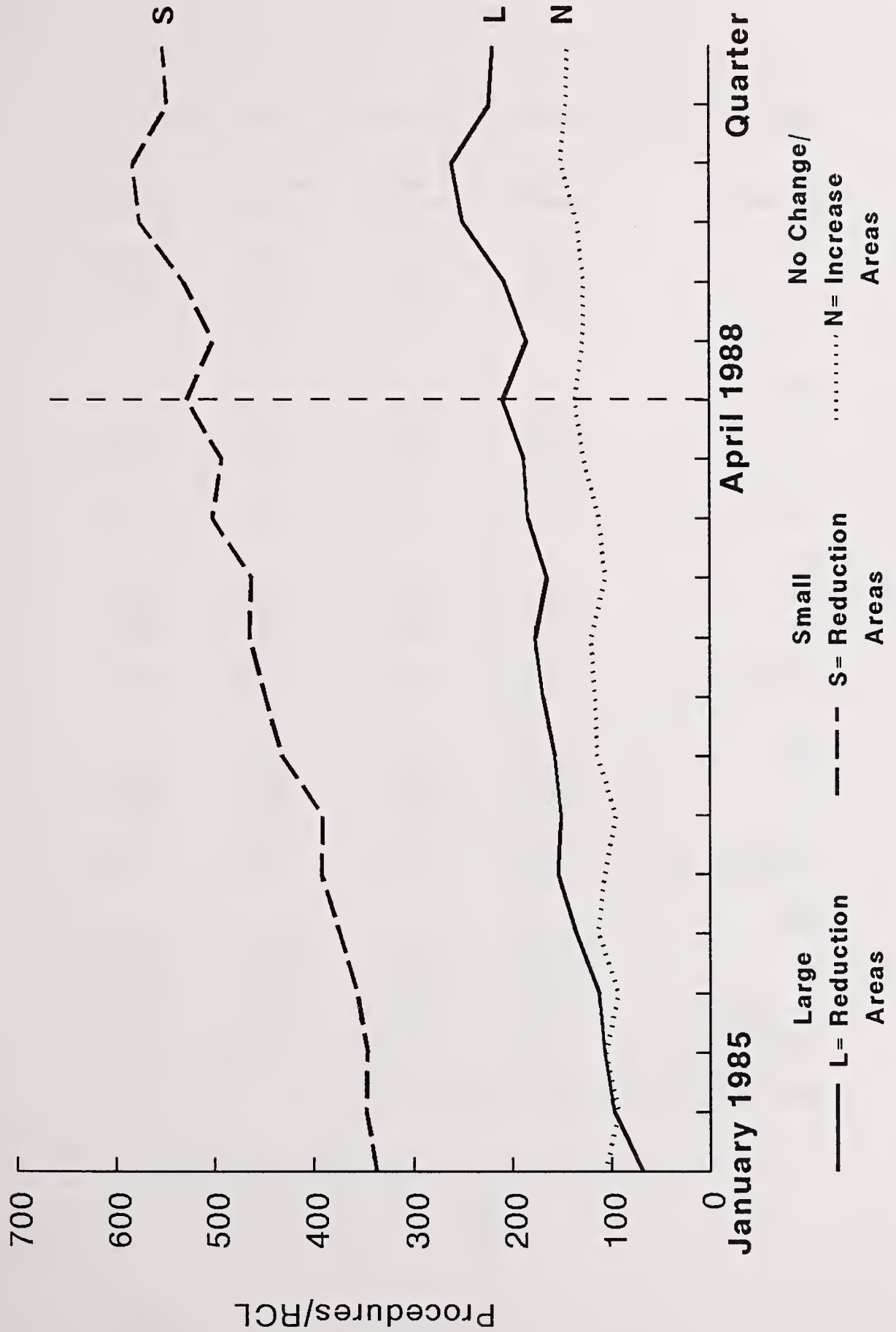


TABLE 14-10

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: UPPER GI
ENDOSCOPY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	702.6	1,562.9	602.3	1349.8
2	722.3	1,647.7	625.1	1420.1
3	762.0	1,681.8	638.2	1451.4
4	790.3	1,740.1	626.3	1496.7
Average	744.3	1658.1	623.0	1429.5
<u>1986</u>				
1	783.7	1,832.4	696.2	1576.2
2	815.7	1,895.1	712.6	1629.3
3	851.5	1,878.4	677.6	1614.0
4	808.0	1,921.8	717.0	1649.9
Average	814.7	1881.9	700.8	1617.4
Percent Change	9.5%	13.5%	12.5%	13.1%
<u>1987</u>				
1	856.1	2,013.7	784.3	1733.1
2	955.7	2,118.4	816.2	1826.2
3	934.1	2,137.4	873.7	1847.9
4	936.2	2,235.1	859.7	1920.9
Average	920.5	2126.1	833.5	1832.0
Percent Change	13.0%	13.0%	18.9%	13.3%
<u>1988</u>				
1	939.2	2,189.9	946.6	1898.3
2	1,034.4	2,323.7	942.6	2007.6
3	1,021.7	2,282.8	944.8	1975.7
4	1,000.2	2,261.2	945.8	1957.6
Average	998.9	2264.4	944.9	1959.8
Percent Change	8.5%	6.5%	13.4%	7.0%
<u>1989</u>				
1	1,137.9	2,375.4	1,051.2	2070.6
2	1,160.0	2,458.7	1,033.9	2133.3
3	1,098.1	2,402.5	939.5	2070.7
4	1,104.4	2,402.5	1,009.0	2082.1
Average	1125.1	2409.8	1008.4	2089.2
Percent Change	12.6%	6.4%	6.7%	6.6%

Source: Medicare Part B claims from eleven states.

Figure 14-7

Volume Trends for Upper GI Endoscopy

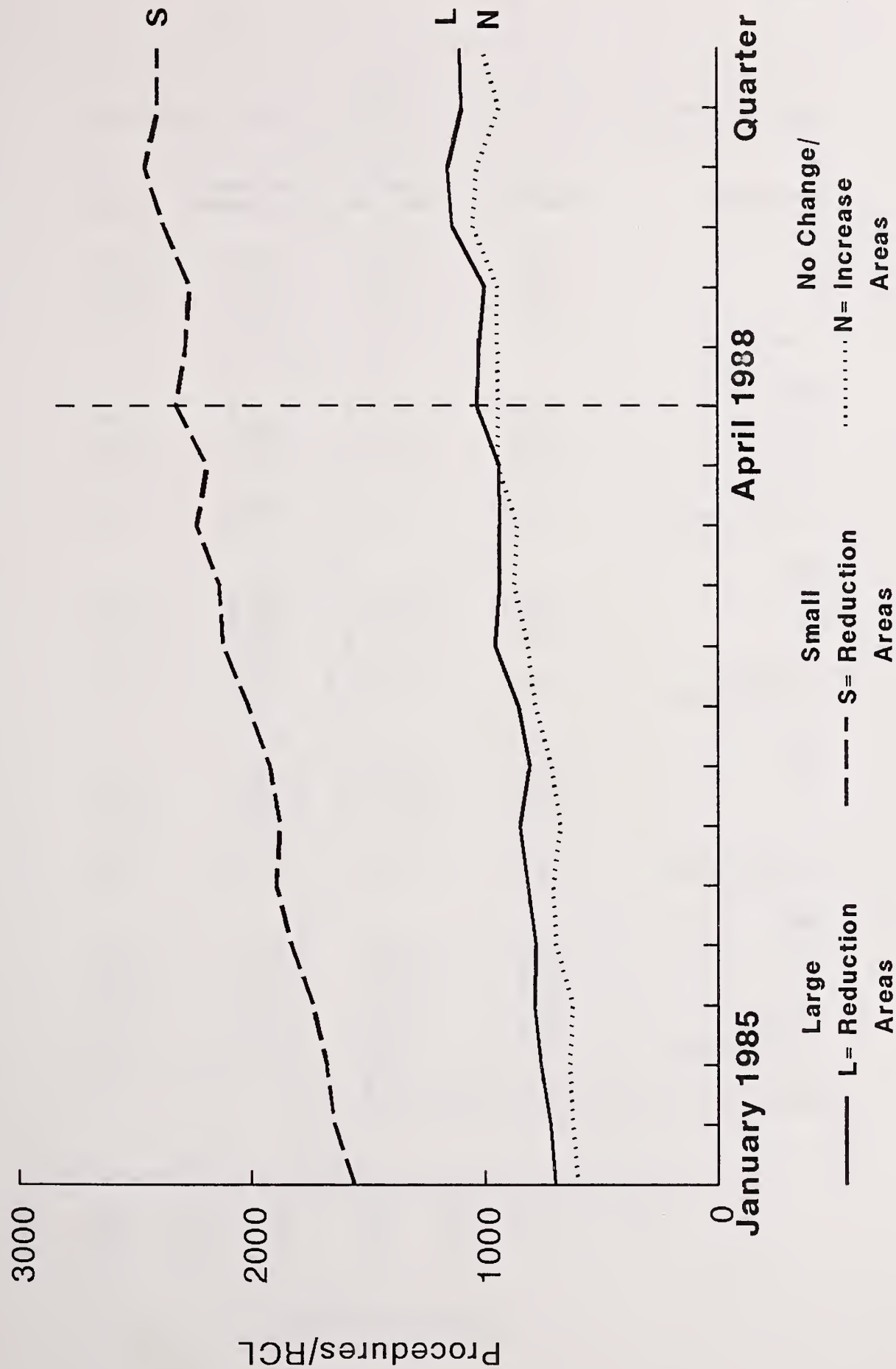


TABLE 14-11

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: TRANSURETHRAL PROSTATECTOMY (TURP)

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	445.0	483.3	602.3	567.2
2	404.0	473.6	580.0	547.6
3	396.0	475.7	593.6	557.6
4	395.0	489.6	584.0	554.3
Average	410.0	480.6	590.0	556.7
<u>1986</u>				
1	386.0	476.8	602.6	564.0
2	459.0	492.8	584.7	557.4
3	444.0	487.4	569.2	544.5
4	410.0	475.2	585.1	551.8
Average	424.8	483.0	585.4	554.5
Percent Change	3.6%	0.5%	-0.8%	-0.4%
<u>1987</u>				
1	459.0	552.6	686.5	645.6
2	423.0	509.2	584.4	560.5
3	428.0	497.8	602.7	570.7
4	449.0	514.7	611.6	582.1
Average	439.8	518.5	621.3	589.7
Percent Change	3.5%	7.3%	6.1%	6.4%
<u>1988</u>				
1	430.0	491.1	618.0	580.1
2	422.0	497.1	571.9	548.4
3	368.0	463.7	546.3	520.0
4	390.0	472.4	591.5	555.2
Average	402.5	481.1	581.9	550.9
Percent Change	-8.5%	-7.2%	-6.3%	-6.6%
<u>1989</u>				
1	439.0	472.0	608.9	569.0
2	381.0	438.0	550.9	517.2
3	403.0	390.2	529.6	490.3
4	364.0	363.8	551.0	497.8
Average	396.8	416.0	560.1	518.6
Percent Change	-1.4%	-13.5%	-3.8%	-5.9%

Source: Medicare Part B claims from eleven states.

Figure 14-8
Volume Trends for TURP

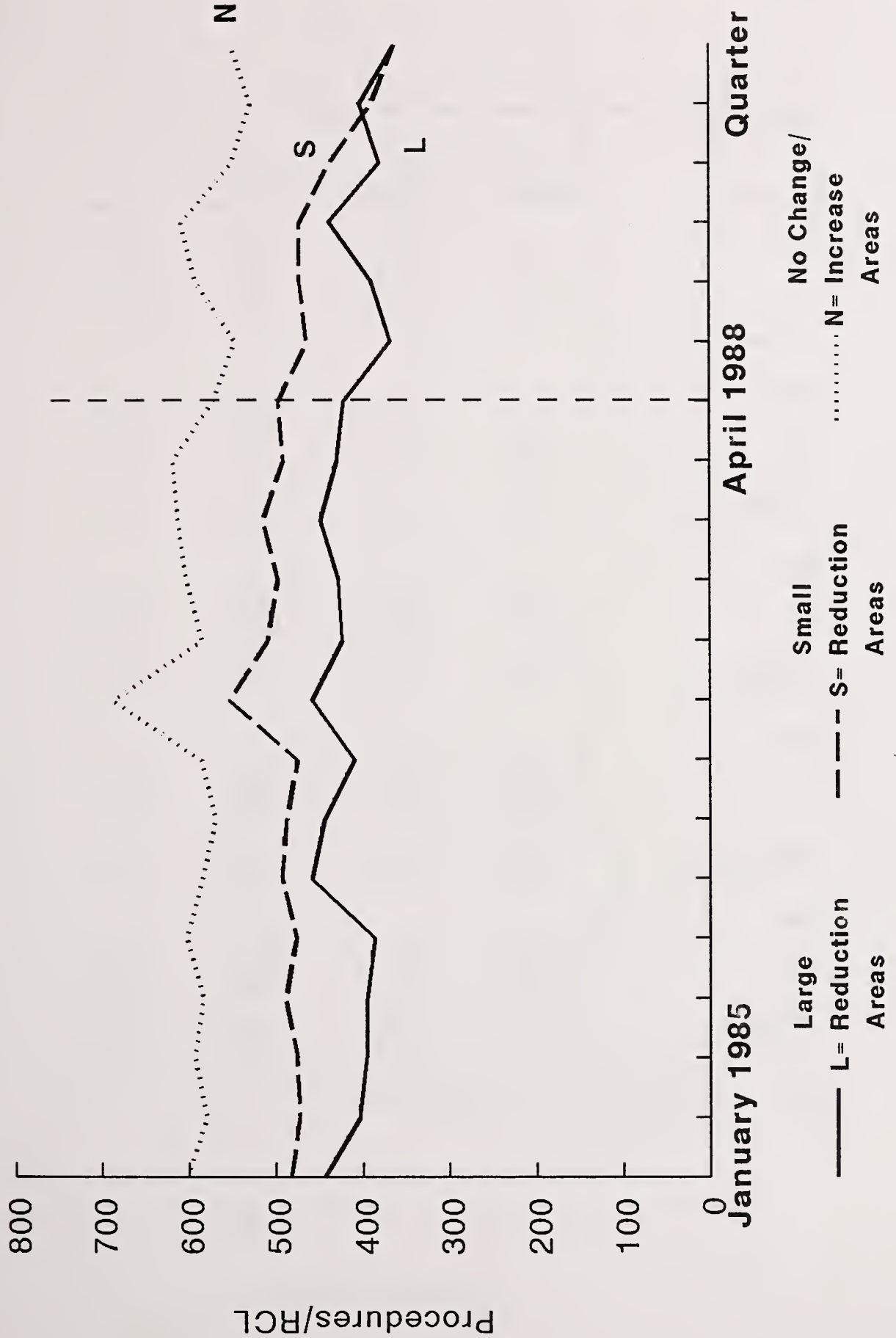


TABLE 14-12

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: SUPRAPUBIC PROSTATECTOMY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	3.5	19.1	23.8	20.5
2	3.9	20.9	20.8	19.6
3	5.7	20.2	18.9	18.5
4	7.0	21.2	19.9	19.5
Average	5.0	20.4	20.9	19.5
<u>1986</u>				
1	4.9	17.2	18.5	17.0
2	3.5	21.9	17.0	18.0
3	5.3	21.0	16.5	17.5
4	5.3	17.1	15.8	15.6
Average	4.7	19.3	16.9	17.0
Percent Change	-6.1%	-5.1%	-18.8%	-12.8%
<u>1987</u>				
1	4.5	20.7	18.6	18.4
2	6.0	18.8	16.5	16.7
3	2.9	17.8	18.6	17.1
4	4.3	20.6	21.0	19.6
Average	4.4	19.5	18.7	18.0
Percent Change	-6.1%	0.8%	10.3%	5.6%
<u>1988</u>				
1	3.0	15.6	16.9	15.3
2	5.4	14.9	13.3	13.3
3	3.8	17.9	12.7	14.1
4	5.3	14.8	14.3	13.8
Average	4.4	15.8	14.3	14.2
Percent Change	-1.2%	-18.9%	-23.5%	-21.1%
<u>1989</u>				
1	3.6	12.1	13.1	12.0
2	5.4	17.3	13.3	14.3
3	4.9	15.5	14.5	14.2
4	6.4	14.1	15.3	14.2
Average	5.1	14.8	14.0	13.7
Percent Change	15.6%	-6.6%	-1.7%	-3.5%

Source: Medicare Part B claims from eleven states.

Figure 14-9
Volume Trends for Suprapubic Prostatectomy

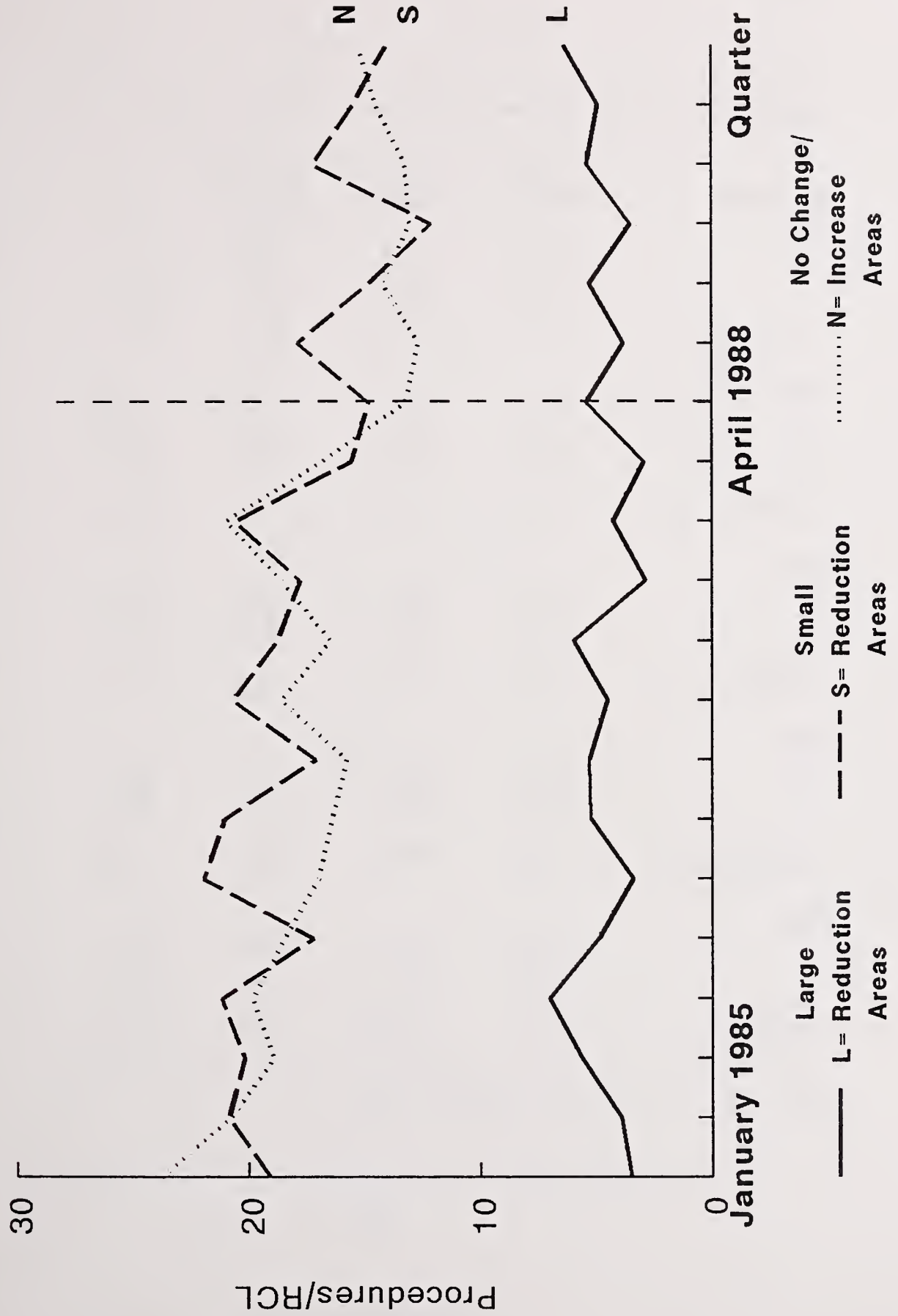


TABLE 14-13

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: DILATION & CURETTAGE (D & C)

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	53.4	154.8	73.6	109.2
2	62.1	152.9	78.0	111.5
3	85.6	158.0	74.2	118.0
4	111.9	159.7	73.8	124.5
Average	78.2	156.3	74.9	115.8
<u>1986</u>				
1	126.5	160.3	77.9	129.0
2	124.0	174.6	83.6	137.2
3	120.4	170.6	79.9	133.4
4	102.4	158.1	72.3	121.1
Average	118.3	165.9	78.4	130.2
Percent Change	51.2%	6.1%	4.7%	12.4%
<u>1987</u>				
1	132.9	157.3	76.1	128.4
2	137.6	168.3	81.4	136.4
3	126.7	166.1	84.0	133.6
4	121.7	158.5	86.1	129.4
Average	129.7	162.5	81.9	132.0
Percent Change	9.7%	-2.0%	4.4%	1.4%
<u>1988</u>				
1	124.7	164.1	69.9	128.1
2	140.1	179.9	79.9	142.1
3	124.3	164.0	76.1	129.7
4	122.3	157.4	69.0	124.0
Average	127.8	166.4	73.7	131.0
Percent Change	-1.5%	2.4%	-10.0%	-0.7%
<u>1989</u>				
1	131.1	114.8	56.8	101.4
2	142.9	124.9	55.7	108.6
3	123.1	121.5	52.0	101.6
4	117.8	112.2	54.0	96.5
Average	128.7	118.3	54.6	102.0
Percent Change	0.7%	-28.9%	-25.9%	-22.1%

Source: Medicare Part B claims from eleven states.

Figure 14-10

Volume Trends for D&C

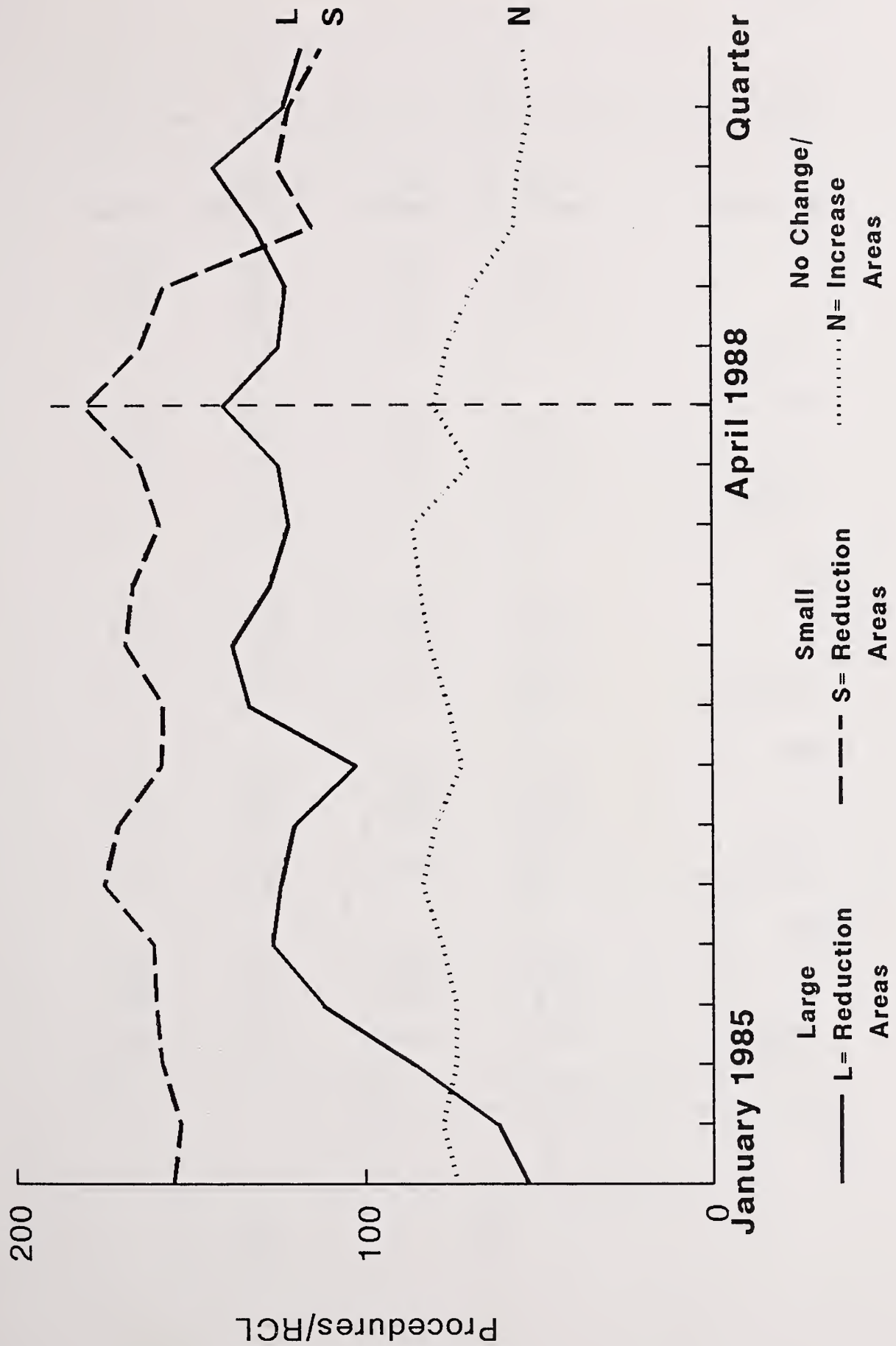


TABLE 14-14

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CARPAL TUNNEL RELEASE

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
<u>1985</u>				
1	69.0	134.0	41.6	105.1
2	74.5	154.3	44.7	119.2
3	69.6	145.7	36.1	111.8
4	76.6	153.9	21.9	117.4
Average	72.4	147.0	36.1	113.4
<u>1986</u>				
1	78.5	154.2	40.5	119.8
2	82.7	161.8	43.8	126.0
3	72.4	151.6	37.0	116.1
4	69.3	155.9	25.5	116.5
Average	75.7	155.9	36.7	119.6
Percent Change	4.6%	6.1%	1.7%	5.5%
<u>1987</u>				
1	78.1	169.3	52.1	129.7
2	79.1	174.6	55.2	133.5
3	77.7	157.4	48.1	122.2
4	86.4	187.4	57.2	143.5
Average	80.3	172.2	53.1	132.2
Percent Change	6.1%	10.5%	44.9%	10.5%
<u>1988</u>				
1	93.6	190.6	65.6	148.4
2	89.1	205.5	68.1	156.0
3	99.9	189.5	59.0	149.0
4	87.2	199.2	71.0	152.0
Average	92.4	196.2	65.9	151.4
Percent Change	15.1%	14.0%	24.0%	14.5%
<u>1989</u>				
1	101.5	207.0	73.7	161.2
2	93.9	214.9	70.6	163.2
3	90.0	193.9	64.7	149.0
4	101.9	201.5	79.2	158.6
Average	96.8	204.3	72.1	158.0
Percent Change	4.7%	4.1%	9.3%	4.4%

Source: Medicare Part B claims from eleven states.

Figure 14-11
Volume Trends for Carpal Tunnel Release

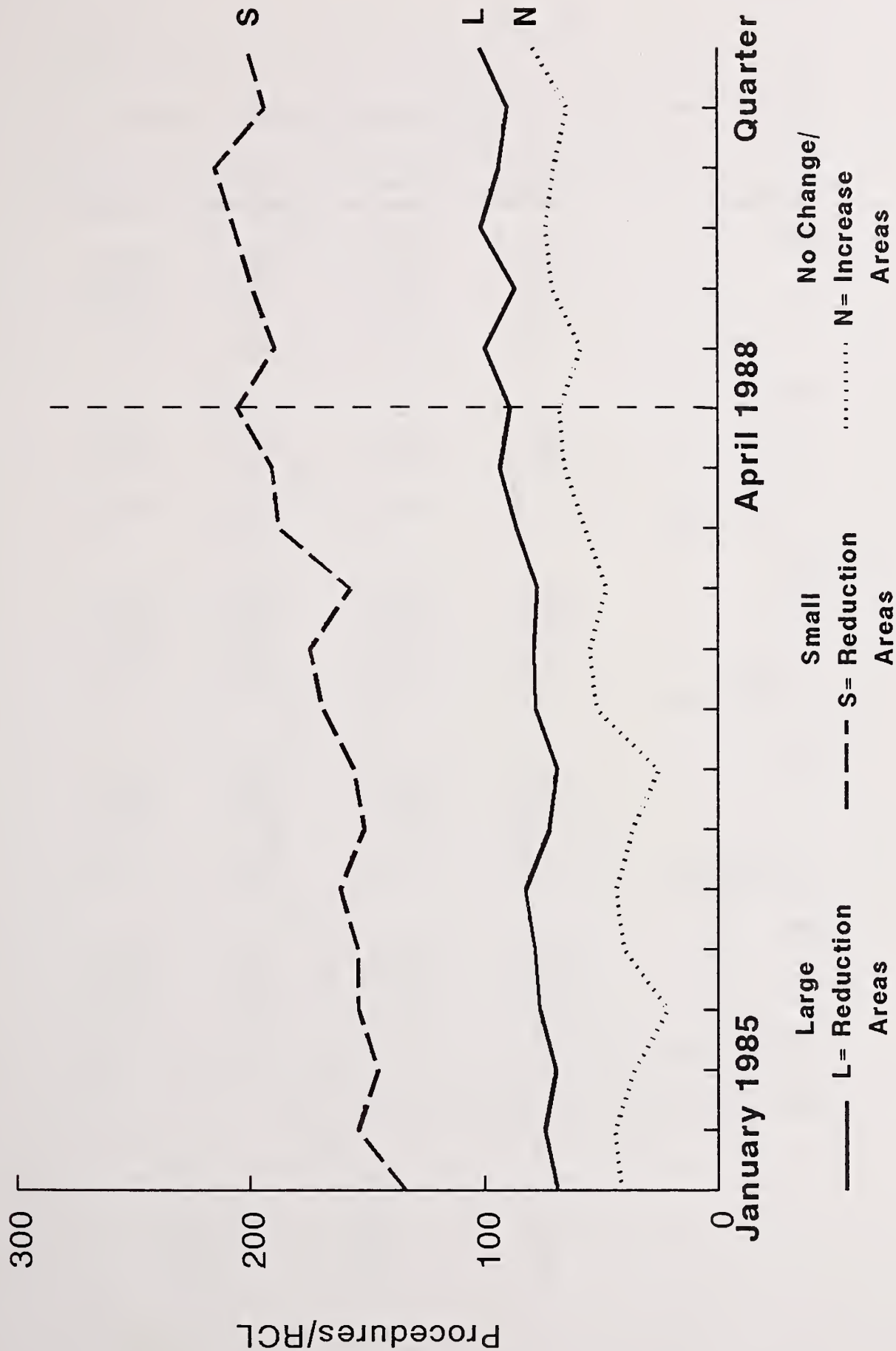


TABLE 14-15

QUARTERLY TRENDS IN THE MEAN NUMBER OF PROCEDURES PER LOCALITY: CATARACT SURGERY

<u>Year/Quarter</u>	<u>Large Reduction</u>	<u>Small Reduction</u>	<u>No Change or Increase</u>	<u>All Areas</u>
1985				
1	1,846.4	882.9	464.7	1526.7
2	2,416.5	1,087.0	524.3	1977.9
3	2,174.7	1,004.1	510.2	1788.8
4	2,337.5	1,019.7	600.0	1926.1
Average	2,193.8	998.4	524.8	1,804.9
1986				
1	2,049.9	992.7	536.1	1698.5
2	2,624.7	1,086.8	616.8	2146.5
3	2,500.7	1,069.4	608.9	2051.7
4	2,608.1	1,121.8	645.1	2142.2
Average	2,445.8	1,067.7	601.7	2,009.7
Percent Change	11.5%	6.9%	14.7%	11.4%
1987				
1	2,263.1	998.9	630.8	1872.3
2	2,738.4	1,104.0	718.4	2248.4
3	2,673.8	1,095.7	761.8	2207.3
4	2,749.5	1,105.6	756.6	2263.3
Average	2,606.2	1,076.0	716.9	2,147.8
Percent Change	6.6%	0.8%	19.1%	6.9%
1988				
1	2,331.6	1,177.5	597.3	1932.2
2	2,914.5	1,236.3	748.3	2394.3
3	2,541.1	1,048.1	632.3	2081.4
4	2,671.9	1,135.8	673.3	2193.0
Average	2,614.8	1,149.4	662.8	2,150.2
Percent Change	0.3%	6.8%	-7.5%	0.1%
1989				
1	2,362.6	1,235.0	721.9	1980.7
2	2,814.8	1,230.0	803.3	2328.1
3	2,615.0	1,252.6	794.2	2181.0
4	2,642.2	1,218.3	802.3	2199.4
Average	2,608.7	1,234.0	780.4	2,172.3
Percent Change	-0.2%	7.4%	17.7%	1.0%

Source: Medicare Part B claims from eleven states.

Figure 14-12

Volume Trends for Cataract Surgery

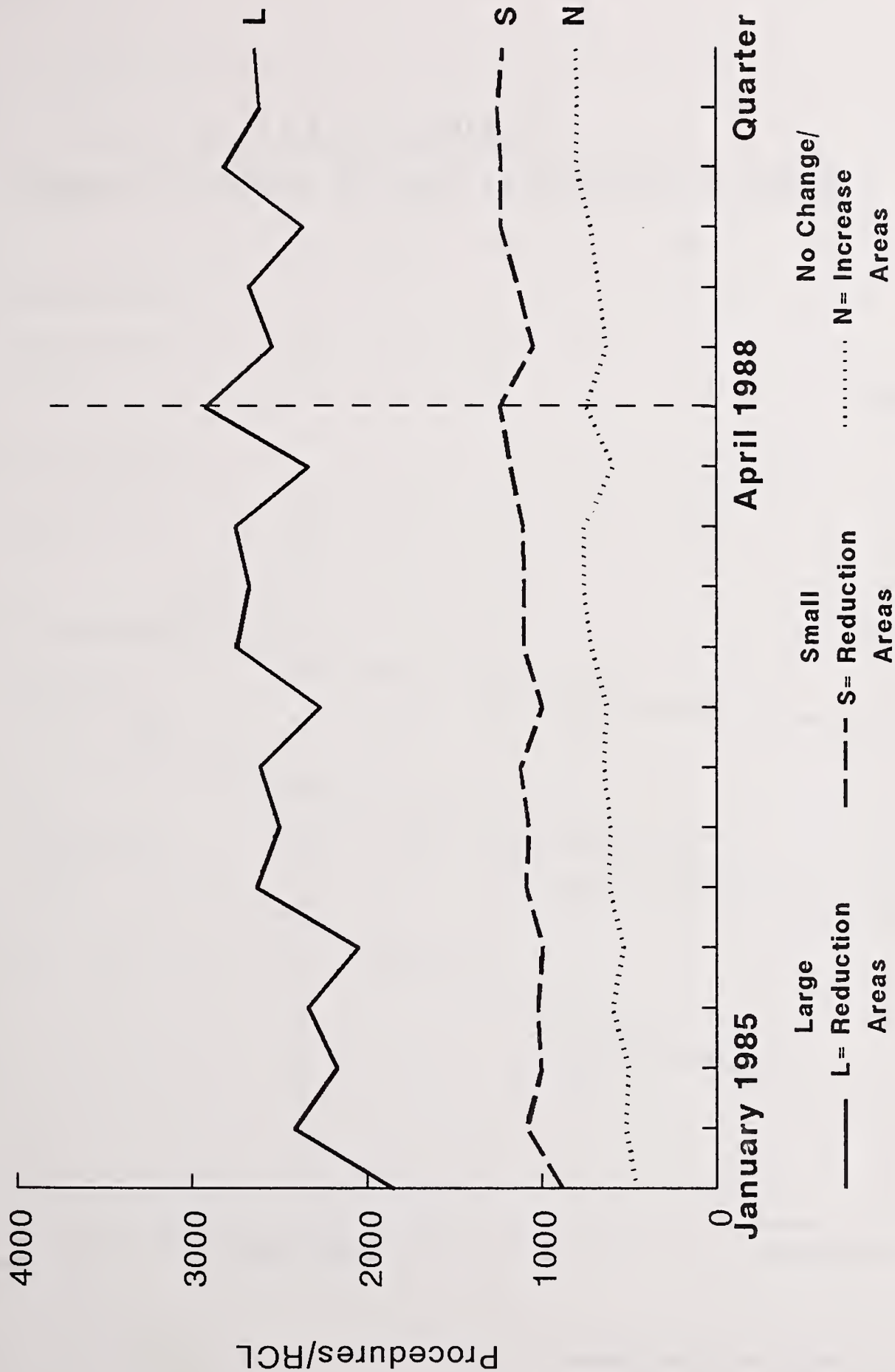
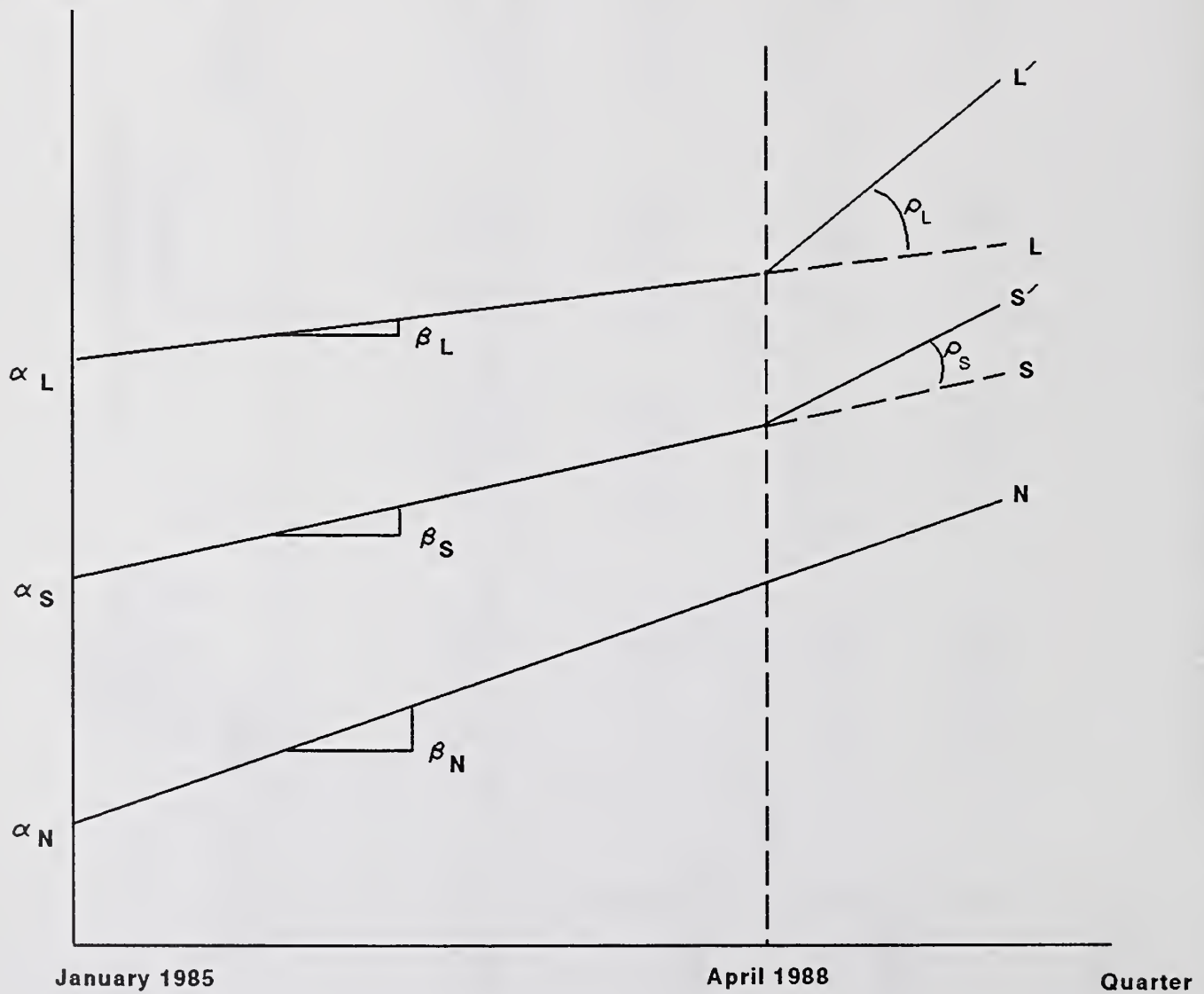


Figure 14-13

Model of Statistical Test for Volume Change

Procedures
RCL



L = Large reduction areas
S = Small reduction areas
N = No change/increase areas

TABLE 14-16

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: TOTAL HIP
REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Basic Replacements	76.0%	73.6%	74.1%	78.9%	79.5%
Conversion	12.4	16.9	12.5	7.4	5.0
Revisions	11.6	9.5	13.4	13.7	15.5
<u>Small Reduction Areas</u>					
Basic Replacements	78.6%	75.2%	77.2%	80.9%	82.1%
Conversion	11.2	14.1	11.1	6.8	5.5
Revisions	10.2	10.7	11.7	12.2	12.4
<u>No Change/Increase Areas</u>					
Basic Replacements	78.9%	72.2%	78.1%	81.5%	77.7%
Conversion	8.7	14.4	7.5	4.7	4.6
Revisions	12.5	13.4	14.4	13.9	17.7
<u>All Areas</u>					
Basic Replacements	78.2%	73.9%	76.8%	80.6%	80.1%
Conversion	10.6	14.8	10.3	6.3	5.1
Revisions	11.2	11.3	12.9	13.1	14.7

Source: Medicare Part B claims from eleven states.

TABLE 14-17

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Basic Replacements	96.0%	96.0%	94.5%	94.0%	93.2%
Revisions	4.0	4.0	5.5	6.0	6.8
<u>Small Hit Areas</u>					
Basic Replacements	94.9%	94.0%	92.9%	94.2%	91.3%
Revisions	3.4	4.0	5.0	5.8	6.7
<u>No Change/Increase Areas</u>					
Basic Replacements	97.5%	95.5%	95.7%	96.0%	94.4%
Revisions	2.5	4.5	4.3	4.0	5.6
<u>All Areas</u>					
Basic Replacements	95.9%	95.0%	94.0%	94.5%	92.5%
Revisions	3.3	4.1	5.1	5.5	6.5

Source: Medicare Part B claims from eleven states.

TABLE 14-18

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
With Meniscectomy	81.3%	98.6%	94.2%	97.4%	97.6%
With Meniscus Repair	0.3	1.4	5.3	2.6	2.4
<u>Small Reduction Areas</u>					
With Meniscectomy	86.1%	97.0%	96.4%	95.9%	95.7%
With Meniscus Repair	0.0	3.0	3.6	4.1	4.3
<u>No Change/Increase Areas</u>					
With Meniscectomy	79.8%	98.3%	97.1%	97.8%	96.3%
With Meniscus Repair	0.0	1.7	2.9	2.2	3.7
<u>All Areas</u>					
With Meniscectomy	83.3%	97.7%	96.0%	96.7%	96.3%
With Meniscus Repair	0.1	2.3	3.9	3.3	3.7

Source: Medicare Part B claims from eleven states.

TABLE 14-19

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: PERMANENT
PACEMAKER INSERTION

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Atrial	61.3%	21.3%	16.8%	11.4%	9.4%
Ventricular	28.2	62.9	67.2	69.3	66.8
AV-sequential	10.5	15.8	16.0	19.3	23.8
<u>Small Reduction Areas</u>					
Atrial	31.7%	23.3%	19.9%	15.5%	13.4%
Ventricular	48.1	56.2	58.7	62.2	61.1
AV-sequential	19.7	20.2	21.4	22.3	25.5
<u>No Change/Increase Areas</u>					
Atrial	26.4%	22.1%	22.1%	15.5%	12.5%
Ventricular	57.6	60.6	57.5	59.0	55.7
AV-sequential	13.5	17.3	20.5	21.9	28.3
<u>All Areas</u>					
Atrial	33.4%	22.7%	20.1%	14.9%	12.6%
Ventricular	48.7	58.3	59.5	62.3	60.4
AV-sequential	16.8	18.8	20.4	21.8	26.0

Source: Medicare Part B claims from eleven states.

TABLE 14-20

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY
BYPASS GRAFT (CABG) SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Area</u>					
Single Graft	6.3%	5.3%	4.4%	5.0%	7.7%
Two Grafts	16.3	14.7	16.4	17.4	17.4
Three Grafts	32.5	36.9	36.3	39.2	39.9
Four Grafts	34.3	30.1	30.0	27.8	24.7
Five Grafts	9.5	11.0	10.0	8.7	8.5
Six or more Grafts	1.0	2.0	2.8	1.9	1.8
<u>Small Reduction Area</u>					
Single Graft	6.9%	6.9%	6.5%	6.8%	7.1%
Two Grafts	18.6	17.5	16.5	17.5	16.4
Three Grafts	32.9	32.7	33.5	32.9	32.4
Four Grafts	27.1	27.8	28.0	28.3	29.1
Five Grafts	11.1	11.3	12.1	10.8	11.6
Six or more Grafts	3.4	3.8	3.5	3.7	3.5
<u>No Change/Increase Area</u>					
Single Graft	7.1%	6.5%	5.0%	8.0%	9.2%
Two Grafts	11.2	13.0	13.5	18.7	19.6
Three Grafts	20.3	23.5	25.1	30.5	31.0
Four Grafts	18.7	20.7	20.7	27.7	26.5
Five Grafts	6.9	8.5	8.5	12.8	11.0
Six or more Grafts	35.8	27.8	27.1	2.2	2.6
<u>All Areas</u>					
Single Graft	6.8%	6.3%	5.5%	6.5%	7.7%
Two Grafts	16.0	15.6	15.8	17.7	17.4
Three Grafts	29.4	32.0	32.6	34.4	34.5
Four Grafts	26.9	27.0	27.1	28.0	27.2
Five Grafts	9.5	10.6	10.7	10.6	10.5
Six or more Grafts	11.5	8.4	8.4	2.8	2.8

Source: Medicare Part B claims from eleven states.

TABLE 14-21

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: UPPER GI
ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Basic	58.2%	57.9%	57.8%	57.8%	54.7%
With Biopsy	41.8	42.1	42.2	42.2	45.3
<u>Small Reduction Areas</u>					
Basic	63.6%	63.8%	62.9%	61.6%	58.9%
With Biopsy	36.4	36.2	37.1	38.4	39.8
<u>No Change/Increase Areas</u>					
Basic	63.1%	61.8%	64.4%	63.9%	61.0%
With Biopsy	36.9	38.2	35.6	36.1	39.0
<u>All Areas</u>					
Basic	63.1%	63.0%	62.7%	61.6%	58.9%
With Biopsy	36.9	37.0	37.3	38.4	40.1

Source: Medicare Part B claims from eleven states.

TABLE 14-22

CHANGES IN PROCEDURE CODE MIX BY SIZE OF PAYMENT REDUCTIONS: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Cataract Extraction	4.0%	2.1%	1.4%	0.9%	0.6%
Extraction + IOL Insertion	86.0	88.3	92.1	94.0	95.2
Other	6.4	5.9	3.4	2.1	1.6
<u>Small Hit Areas</u>					
Cataract Extraction	2.0%	1.4%	0.9%	0.7%	0.5%
Extraction + IOL Insertion	88.8	90.9	93.4	95.2	95.2
Other	4.3	3.4	1.5	1.0	0.8
<u>No Change/Increase Areas</u>					
Cataract Extraction	2.5%	1.9%	1.0%	0.6%	0.4%
Extraction + IOL Insertion	92.4	92.0	94.8	96.0	96.2
Other	1.5	1.9	0.9	0.8	0.7
<u>All Areas</u>					
Cataract Extraction	3.5%	2.0%	1.3%	0.8%	0.6%
Extraction + IOL Insertion	87.5	89.1	92.7	94.4	95.4
Other	5.2	5.0	2.8	1.8	1.3

Source: Medicare Part B claims from eleven states.

TABLE 14-23

CHANGES IN SPECIALTY MIX BY SIZE OF PAYMENT REDUCTIONS: BRONCHOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Internist	24.8%	24.1%	23.0%	20.7%	19.8%
Pulmonary Disease Specialist	37.1	44.5	46.6	46.3	48.2
Other Specialist	32.1	25.2	24.0	28.0	28.0
Other	6.1	6.3	6.4	5.1	4.1
<u>Small Reduction Areas</u>					
Internist	24.1%	24.7%	24.1%	20.2%	18.1%
Pulmonary Disease Specialist	37.1	36.6	37.0	42.3	44.8
Other Specialist	33.4	33.3	33.2	33.4	32.4
Other	5.4	5.4	5.6	4.1	4.7
<u>No Change/Increase Areas</u>					
Internist	33.2%	33.4%	35.7%	30.5%	26.4%
Pulmonary Disease Specialist	16.8	19.2	19.5	26.8	27.7
Other Specialist	36.4	29.3	29.7	26.5	28.9
Other	13.6	18.2	15.0	16.3	17.0
<u>All Areas</u>					
Internist	26.3%	26.3%	26.3%	22.4%	20.2%
Pulmonary Disease Specialist	32.4	34.9	35.7	40.0	42.0
Other Specialist	33.8	30.5	30.3	30.7	30.6
Other	7.5	8.3	7.8	6.9	7.1

Source: Medicare Part B claims from eleven states.

TABLE 14-24

CHANGES IN SPECIALTY MIX BY SIZE OF PAYMENT REDUCTIONS: UPPER GI ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
General Surgeon	11.4%	10.4%	11.8%	15.3%	12.8%
Internist	35.9	37.1	36.7	24.5	23.9
Gastroenterologist	44.7	44.4	44.2	52.4	53.1
Other	7.9	8.1	7.3	7.8	10.2
<u>Small Reduction Areas</u>					
General Surgeon	15.2%	13.7%	13.9%	13.8%	13.9%
Internist	32.3	30.7	29.7	23.4	22.6
Gastroenterologist	44.8	47.4	48.0	54.6	53.6
Other	7.7	8.1	8.4	8.2	9.9
<u>No Change/Increase Areas</u>					
General Surgeon	20.0%	14.7%	14.4%	14.2%	16.4%
Internist	37.2	36.6	35.9	35.9	32.5
Gastroenterologist	32.0	38.2	39.5	38.6	40.6
Other	10.8	10.5	10.2	11.3	10.5
<u>All Areas</u>					
General Surgeon	15.9%	13.6%	13.8%	14.0%	14.2%
Internist	33.5	32.1	31.2	25.4	24.2
Gastroenterologist	42.3	45.8	46.4	52.0	51.6
Other	8.3	8.5	8.6	8.7	10.0

Source: Medicare Part B claims from eleven states.

TABLE 14-25

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	2.4%	4.1%	5.3%	4.3%	5.0%
Inpatient	57.0	53.7	47.1	38.5	32.9
OPD/ASC	22.1	42.2	46.9	56.8	61.6
<u>Small Reduction Areas</u>					
Office	8.0%	4.2%	4.0%	3.7%	4.3%
Inpatient	57.6	46.0	36.9	31.1	27.3
OPD/ASC	20.5	49.0	58.1	63.5	66.8
<u>No Change/Increase Areas</u>					
Office	4.0%	3.4%	5.0%	2.9%	3.3%
Inpatient	52.8	52.9	39.7	35.0	29.7
OPD/ASC	22.6	43.4	55.0	61.7	66.0
<u>All Areas</u>					
Office	5.5%	4.0%	4.6%	3.7%	4.2%
Inpatient	56.3	49.4	40.1	33.9	29.3
OPD/ASC	21.4	46.1	54.5	61.4	65.3

Source: Medicare Part B claims from eleven states.

TABLE 14-26

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	7.4%	4.9%	5.4%	5.4%	6.25
Inpatient	78.7	82.4	80.0	80.6	78.3
OPD/ASC	13.8	12.6	14.5	13.9	15.1
<u>Small Reduction Areas</u>					
Office	4.6%	4.0%	4.2%	4.0%	4.1%
Inpatient	81.3	78.4	76.2	74.2	71.6
OPD/ASC	13.9	17.4	19.3	21.3	23.4
<u>No Change/Increase Areas</u>					
Office	8.3%	7.3%	6.7%	5.5%	6.5%
Inpatient	80.5	77.4	75.9	72.0	65.5
OPD/ASC	11.1	15.3	17.4	22.6	23.2
<u>All Areas</u>					
Office	6.2%	4.9%	5.0%	4.6%	5.1%
Inpatient	80.5	79.1	77.0	75.3	72.0
OPD/ASC	13.3	15.8	17.8	19.8	21.3

Source: Medicare Part B claims from eleven states.

TABLE 14-27

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: UPPER GI
ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	12.0%	12.9%	14.0%	13.7%	11.8%
Inpatient	60.7	57.9	53.5	58.2	50.6
OPD/ASC	27.0	29.0	32.2	27.2	35.4
<u>Small Reduction Areas</u>					
Office	12.8%	11.1%	11.2%	10.8%	10.3%
Inpatient	62.8	61.4	57.7	56.2	53.1
OPD/ASC	24.2	27.0	30.5	32.1	34.0
<u>No Change/Increase Areas</u>					
Office	14.5%	15.4%	14.0%	13.4%	12.9%
Inpatient	62.9	57.4	52.7	49.8	48.2
OPD/ASC	22.3	27.1	33.3	36.8	38.5
<u>All Areas</u>					
Office	13.1%	11.9%	11.9%	11.4%	10.8%
Inpatient	62.7	60.5	56.6	55.4	52.2
OPD/ASC	24.0	27.2	31.0	32.5	34.8

Source: Medicare Part B claims from eleven states.

TABLE 14-28

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	11.5%	10.1%	11.0%	12.8%	12.0%
Inpatient	63.1	59.2	51.9	47.7	40.4
OPD/ASC	25.4	30.2	36.7	38.2	46.5
<u>Small Reduction Areas</u>					
Office	12.1%	10.9%	12.8%	13.4%	11.5%
Inpatient	51.6	47.4	37.7	36.0	29.9
OPD/ASC	35.6	41.0	48.2	49.0	56.6
<u>No Change/Increase Areas</u>					
Office	10.3%	12.5%	12.0%	10.8%	10.8%
Inpatient	52.9	40.8	37.4	33.4	29.5
OPD/ASC	36.5	46.2	50.2	55.0	57.9
<u>All Areas</u>					
Office	11.4%	11.2%	12.1%	12.5%	11.4%
Inpatient	54.4	48.1	40.7	37.8	32.1
OPD/ASC	33.8	40.2	46.3	48.4	54.8

Source: Medicare Part B claims from eleven states.

TABLE 14-29

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL
RELEASE

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	8.3%	7.7%	9.1%	8.0%	6.9%
Inpatient	50.1	46.8	40.3	36.8	35.9
OPD/ASC	41.5	45.4	50.5	54.9	56.7
<u>Small Reduction Areas</u>					
Office	8.2%	7.6%	7.5%	6.9%	6.2%
Inpatient	37.7	35.1	29.9	27.3	23.9
OPD/ASC	53.3	56.2	61.2	63.8	67.4
<u>No Change/Increase Areas</u>					
Office	2.4%	6.1%	4.6%	8.9%	2.8%
Inpatient	48.1	41.2	36.5	25.9	24.2
OPD/ASC	49.5	52.3	58.7	65.2	62.3
<u>All Areas</u>					
Office	7.7%	7.5%	7.7%	7.5%	6.0%
Inpatient	42.6	39.3	33.7	30.1	27.7
OPD/ASC	49.2	52.5	57.7	61.2	63.6

Source: Medicare Part B claims from eleven states.

TABLE 14-30

CHANGES IN LOCATION OF SERVICE BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Large Reduction Areas</u>					
Office	7.8%	7.0%	5.2%	5.2%	5.2%
Inpatient	23.7	14.2	9.4	7.8	6.8
OPD/ASC	67.6	77.8	84.3	85.0	85.1
<u>Small Reduction Areas</u>					
Office	3.3%	2.9%	2.8%	7.0%	5.2%
Inpatient	15.6	8.3	4.8	4.9	5.4
OPD/ASC	81.0	88.8	92.0	85.7	88.9
<u>No Change/Increase Areas</u>					
Office	3.7%	3.5%	3.8%	6.9%	5.1%
Inpatient	13.1	4.9	4.4	3.4	2.6
OPD/ASC	83.2	91.6	91.7	88.3	91.7
<u>All Areas</u>					
Office	6.6%	6.0%	4.7%	5.6%	5.2%
Inpatient	20.8	12.1	8.1	6.8	5.9
OPD/ASC	72.0	81.1	86.3	85.6	86.6

Source: Medicare Part B claims from eleven states.

TABLE 14-31

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	64.9%	65.1%	71.5%	75.1%	74.3%
Small Reduction Areas	56.0	65.2	71.0	74.4	77.0
No Change/Increase Areas	42.2	43.5	52.1	61.7	64.1
All Areas	53.1	58.4	65.2	70.6	72.4

Source: Medicare Part B claims from eleven states.

TABLE 14-32

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	69.7%	71.1%	74.7%	81.5%	80.5%
Small Reduction Areas	51.0	55.0	62.5	70.3	71.2
No Change/Increase Areas	38.4	31.0	43.2	51.4	64.4
All Areas	53.1	56.2	63.1	70.6	73.1

Source: Medicare Part B claims from eleven states.

TABLE 14-33

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	26.4%	41.7%	45.5%	56.7%	61.4%
Small Reduction Areas	47.2	69.7	76.7	83.3	86.0
No Change/Increase Areas	29.5	35.4	54.8	60.6	63.4
All Areas	37.3	55.3	64.0	71.6	74.8

Source: Medicare Part B claims from eleven states.

TABLE 14-34

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	61.3%	63.9%	67.6%	75.1%	76.2%
Small Reduction Areas	76.1	80.1	85.4	88.7	90.4
No Change/Increase Areas	49.0	44.8	57.0	67.2	65.8
All Areas	66.2	68.9	75.2	80.9	81.8

Source: Medicare Part B claims from eleven states.

TABLE 14-35

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: PERMANENT PACEMAKER INSERTION

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	75.3%	74.4%	76.4%	76.3%	78.3%
Small Reduction Areas	75.6	76.2	80.1	84.8	86.6
No Change/Increase Areas	48.4	50.4	62.1	69.6	72.0
All Areas	67.4	69.0	74.7	79.5	81.5

Source: Medicare Part B claims from eleven states.

TABLE 14-36

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	76.3%	71.1%	73.5%	79.2%	88.4%
Small Reduction Areas	69.5	74.4	79.1	81.8	83.8
No Change/Increase Areas	50.0	58.7	66.4	79.7	92.8
All Areas	66.1	70.0	74.6	80.6	87.2

Source: Medicare Part B claims from eleven states.

TABLE 14-37

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: UPPER GI ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	73.0%	79.6%	82.9%	87.3%	88.1%
Small Reduction Areas	68.9	72.4	77.8	81.1	81.8
No Change/Increase Areas	49.1	51.9	57.1	63.5	66.6
All Areas	65.3	69.8	75.0	78.8	79.9

Source: Medicare Part B claims from eleven states.

TABLE 14-38

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: TRANSURETHRAL PROSTATECTOMY (TURP)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	47.0%	32.0%	32.9%	32.5%	31.0%
Small Reduction Areas	46.4	46.1	56.0	57.5	59.1
No Change/Increase Areas	53.8	57.1	64.5	74.6	77.2
All Areas	51.8	53.5	61.4	69.0	71.2

Source: Medicare Part B claims from eleven states.

TABLE 14-39

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	49.5%	49.7%	58.0%	63.6%	64.1%
Small Reduction Areas	61.5	64.6	70.2	76.6	79.8
No Change/Increase Areas	54.9	58.6	61.8	72.6	71.4
All Areas	56.8	59.6	65.1	72.6	73.9

Source: Medicare Part B claims from eleven states.

TABLE 14-40

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	42.3%	42.9%	52.2%	59.8%	67.0%
Small Reduction Areas	54.6	64.3	68.4	75.0	81.2
No Change/Increase Areas	50.9	56.8	71.8	77.9	71.3
All Areas	50.3	57.0	63.7	70.6	75.9

Source: Medicare Part B claims from eleven states.

TABLE 14-41

CHANGES IN ASSIGNMENT BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
<u>Assignment Rates</u>					
Large Reduction Areas	70.7%	71.1%	78.1%	81.7%	83.6%
Small Reduction Areas	63.7	66.9	82.0	82.2	86.4
No Change/Increase Areas	72.9	75.2	79.3	84.3	90.6
All Areas	70.4	71.4	78.7	82.2	85.0

Source: Medicare Part B claims from eleven states.

TABLE 14-42

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$463	\$482	\$520	\$491	\$506	-5.6%
Small Reduction Areas	462	482	510	501	503	-1.8
No Change/Increase Areas	415	421	441	461	473	4.5
All Areas	448	463	491	486	494	-1.0
<u>Total Liability</u>						
Large Reduction Areas	\$790	\$835	\$812	\$659	\$661	-18.8%
Small Reduction Areas	728	765	753	657	633	-12.7
No Change/Increase Areas	776	826	804	647	623	-19.5
All Areas	757	800	782	655	636	-16.3

Source: Medicare Part B claims from eleven states.

TABLE 14-43

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$444	\$461	\$495	\$482	\$484	-2.8%
Small Reduction Areas	489	504	539	508	512	-5.9
No Change/Increase Areas	431	449	483	475	476	-1.7
All Areas	388	409	444	451	451	1.5
<u>Total Liability</u>						
Large Reduction Areas	\$748	\$766	\$755	\$632	\$629	-16.3%
Small Reduction Areas	727	776	711	632	609	-11.1
No Change/Increase Areas	782	977	854	699	602	-18.1
All Areas	745	810	753	644	614	-14.4

Source: Medicare Part B claims from eleven states.

TABLE 14-44

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$182	\$196	\$221	\$220	\$225	-0.3%
Small Reduction Areas	227	240	293	281	272	-4.0
No Change/Increase Areas	171	189	199	201	207	1.0
All Areas	157	158	189	194	209	2.8
<u>Total Liability</u>						
Large Reduction Areas	\$579	\$560	\$495	\$414	\$397	-16.5%
Small Reduction Areas	289	336	297	241	236	-18.8
No Change/Increase Areas	443	475	340	295	289	-13.3
All Areas	390	423	357	298	289	-16.7

Source: Medicare Part B claims from eleven states.

TABLE 14-45

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: BRONCHOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$51	\$53	\$55	\$55	\$55	-1.0%
Small Reduction Areas	62	63	69	66	66	-4.9
No Change/Increase Areas	47	50	52	51	51	-1.6
All Areas	47	48	50	54	54	6.8
<u>Total Liability</u>						
Large Reduction Areas	\$99	\$101	\$104	\$85	\$82	-17.9%
Small Reduction Areas	63	67	63	58	56	-8.7
No Change/Increase Areas	100	102	90	76	71	-16.1
All Areas	79	82	79	68	65	-13.4

Source: Medicare Part B claims from eleven states.

TABLE 14-46

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: PERMANENT
PACEMAKER INSERTION

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$196	\$204	\$221	\$218	\$223	-1.3%
Small Reduction Areas	253	261	289	265	270	-8.4
No Change/Increase Areas	196	203	218	216	222	-0.5
All Areas	167	179	193	197	202	1.9
<u>Total Liability</u>						
Large Reduction Areas	\$348	\$359	\$377	\$336	\$329	-10.9%
Small Reduction Areas	242	250	256	244	245	-4.7
No Change/Increase Areas	292	316	268	243	238	-9.4
All Areas	270	283	275	256	255	-7.1

Source: Medicare Part B claims from eleven states.

TABLE 14-47

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CORONARY ARTERY
BYPASS GRAFT (CABG) SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$758	\$807	\$869	\$815	\$800	-6.1%
Small Reduction Areas	827	898	989	850	793	-14.1
No Change/Increase Areas	762	800	843	829	823	-1.6
All Areas	609	649	706	737	762	4.3
<u>Total Liability</u>						
Large Reduction Areas	\$1,036	\$1,181	\$1,158	\$1,035	\$903	-10.6%
Small Reduction Areas	984	1,001	943	939	939	-0.4
No Change/Increase Areas	723	777	741	882	802	19.0
All Areas	957	1,023	980	957	898	-2.4

Source: Medicare Part B claims from eleven states.

TABLE 14-48

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: UPPER GI ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$57	\$59	\$63	\$62	\$63	-1.8%
Small Reduction Areas	67	69	76	70	73	-7.3
No Change/Increase Areas	57	59	62	62	62	-1.6
All Areas	53	56	57	58	59	1.0
<u>Total Liability</u>						
Large Reduction Areas	\$80	\$81	\$84	\$77	\$80	-8.0%
Small Reduction Areas	74	76	74	72	72	-2.8
No Change/Increase Areas	82	83	79	77	78	-3.4
All Areas	75	78	75	73	73	-3.3

Source: Medicare Part B claims from eleven states.

TABLE 14-49

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: TRANSURETHRAL PROSTATECTOMY (TURP)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$207	\$211	\$222	\$222	\$224	0.0%
Small Reduction Areas	250	259	278	265	265	-4.6
No Change/Increase Areas	223	225	236	233	234	-1.5
All Areas	200	204	214	216	218	0.9
<u>Total Liability</u>						
Large Reduction Areas	\$490	\$563	\$515	\$489	\$492	-5.0%
Small Reduction Areas	401	433	405	362	345	-10.7
No Change/Increase Areas	306	325	303	276	271	-9.1
All Areas	336	359	335	304	296	-9.4

Source: Medicare Part B claims from eleven states.

TABLE 14-50

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: DILATION & CURETTAGE (D & C)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$48	\$49	\$52	\$51	\$50	-1.6%
Small Reduction Areas	54	56	58	55	54	-5.7
No Change/Increase Areas	49	50	53	52	50	-1.6
All Areas	41	43	45	46	47	2.6
<u>Total Liability</u>						
Large Reduction Areas	\$120	\$137	\$141	\$92	\$79	-35.1%
Small Reduction Areas	88	97	94	71	61	-24.4
No Change/Increase Areas	77	85	88	63	61	-28.8
All Areas	92	102	103	73	65	-28.7

Source: Medicare Part B claims from eleven states.

TABLE 14-51

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CARPAL TUNNEL RELEASE

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1987-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$92	\$95	\$101	\$99	\$100	-1.5%
Small Reduction Areas	99	100	105	99	100	-5.3
No Change/Increase Areas	90	94	99	98	98	-1.0
All Areas	80	86	99	107	106	8.0
<u>Total Liability</u>						
Large Reduction Areas	\$233	\$254	\$244	\$162	\$137	-33.4%
Small Reduction Areas	158	170	162	129	116	-20.8
No Change/Increase Areas	175	191	152	132	127	-13.6
All Areas	182	197	186	139	123	-25.3

Source: Medicare Part B claims from eleven states.

TABLE 14-52

CHANGES IN OUT-OF-POCKET LIABILITY BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>Percent Change 1986-88</u>
<u>Copayments Only</u>						
Large Reduction Areas	\$297	\$307	\$306	\$298	\$303	-2.9%
Small Reduction Areas	307	317	311	301	307	-5.0
No Change/Increase Areas	288	303	315	303	309	0.0
All Areas	260	262	280	281	284	7.3
<u>Total Liability</u>						
Large Reduction Areas	\$420	\$428	\$397	\$365	\$363	-14.7%
Small Reduction Areas	395	401	358	347	347	-13.5
No Change/Increase Areas	371	363	353	327	313	-7.2
All Areas	410	414	386	357	353	-13.8

Source: Medicare Part B claims from eleven states.

TABLE 14-53

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: TOTAL HIP REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.65	0.49	0.50	0.51	0.52
Small Reduction Areas	0.51	0.52	0.53	0.71	0.61
No Change/Increase Areas	0.52	0.59	0.63	0.68	0.71
All Areas	0.54	0.53	0.55	0.66	0.62

Source: Medicare Part B claims from eleven states.

TABLE 14-54

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: TOTAL KNEE REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.46	0.49	0.51	0.48	0.49
Small Reduction Areas	0.61	0.68	0.66	0.74	0.72
No Change/Increase Areas	0.37	0.47	0.52	0.83	0.89
All Areas	0.51	0.57	0.58	0.67	0.67

Source: Medicare Part B claims from eleven states.

TABLE 14-55

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.20	0.26	0.37	0.54	0.50
Small Reduction Areas	0.16	0.27	0.58	0.48	0.35
No Change/Increase Areas	0.08	0.34	0.35	0.50	0.55
All Areas	0.15	0.28	0.48	0.50	0.44

Source: Medicare Part B claims from eleven states.

TABLE 14-56

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: PERMANENT
PACEMAKER INSERTION

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.28	0.24	0.23	0.21	0.08
Small Reduction Areas	0.11	0.09	0.06	0.06	0.05
No Change/Increase Areas	0.13	0.15	0.12	0.11	0.15
All Areas	0.14	0.13	0.10	0.09	0.08

Source: Medicare Part B claims from eleven states.

TABLE 14-57

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CORONARY
ARTERY BYPASS GRAFT (CABG) SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.72	0.61	0.71	0.79	0.73
Small Reduction Areas	0.63	0.68	0.73	0.82	0.87
No Change/Increase Areas	0.68	0.75	0.84	0.94	1.03
All Areas	0.67	0.67	0.74	0.84	0.86

Source: Medicare Part B claims from eleven states.

TABLE 14-58

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CARPAL
TUNNEL RELEASE

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.07	0.08	0.06	0.08	0.08
Small Reduction Areas	0.05	0.04	0.05	0.05	0.05
No Change/Increase Areas	0.15	0.03	0.12	0.07	0.05
All Areas	0.06	0.05	0.06	0.06	0.06

Source: Medicare Part B claims from eleven states.

TABLE 14-59

CHANGE IN USE OF ASSISTANT SURGEONS BY SIZE OF PAYMENT REDUCTION: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Large Reduction Areas	0.38	0.18	0.10	0.12	0.10
Small Reduction Areas	0.28	0.16	0.09	0.05	0.05
No Change/Increase Areas	0.22	0.05	0.04	0.01	0.03
All Areas	0.34	0.15	0.09	0.10	0.08

Source: Medicare Part B claims from eleven states.

15.0 EPISODE OF CARE ANALYSIS

Physicians may respond to fee reductions in a variety of ways. The potential for an increase in procedure volume has received the greatest attention. However, physicians can also respond in other ways that similarly lead to increased Medicare outlays. Examples include the following:

- greater use of surgical assistance;
- more testing;
- provision of more "incidental" procedures; and
- fragmentation of billings.

In order to investigate the importance of such additional "offsetting" effects, this episode-of-care analysis examines the overall pattern and cost of health care services provided in association with a surgical procedure impacted by the fee reductions.

15.1 Analytic Approach

Due to the difficulty and expense of constructing episode-of-care records, the episode-of-care study was limited to the following six procedure groups, which were judged to be broadly representative of the larger universe:

- (1) cataract extractions,
- (2) total hip replacement,
- (3) total knee replacement,
- (4) CABG surgery,
- (5) upper GI endoscopy, and
- (6) prostatectomy.

HCFA's five percent BMAD beneficiary files were used to construct episode-of-care records for over-priced procedures in four years, 1986 through 1989. The data for each "index" procedure (i.e., a procedure impacted by the fee reduction) were organized into three observational periods:

Period I--the 30-day interval prior to surgery;

Period II--the day of surgery (plus the hospital claim, if any); and

Period III--the 90-day interval subsequent to surgery.

In addition, a fourth observational interval (Period IV) was defined as being the entire study interval, accumulating experience for Periods I, II and III. In order to avoid undue complexity, anyone dying before the end of the observational period was excluded. Furthermore, in order to have a complete baseline and follow-up information, index procedures performed in the first 30 days and last 90 days of each year were excluded.

In order to distinguish potential "treatment effects," the 1986-1989 changes in the content of the surgical "episodes" are analyzed in three groups. These groups are designed to reflect varying price impacts -- "low," "medium" and "high" price changes -- and were defined from each carrier's average change in the allowed charge for a given procedure. This was done as follows.

For each procedure group, except cataracts, we arrayed the carriers (including only those carriers with 10 or more procedures in each year) in order of the average percentage change in allowed charge between 1987 and late 1988, which is the average percentage "price" change associated with implementation of OBRA-87. For cataracts, we used a longer interval, arraying carriers in order of the average percentage change in allowed charge between 1986 and late 1988. This longer interval reflects the cumulative "price" change associated with dual implementation of OBRA-87 and OBRA-86. For each procedure group, a "high" impact group was defined to include those carriers with the highest percentage price decreases (or, equivalently, the lowest percentage price increases) accounting for approximately a third of the procedures included in the study. For each procedure group, a "low" impact group was analogously taken as being those carriers with the lowest percentage payment reduction (i.e., the highest percentage price increases), accounting for a second third of study procedures. Finally, those carriers accounting for the remaining middle third of the procedures were considered to constitute the intermediate or "medium" price change group. This design gave approximately equal numbers of procedures in each of three analytic groups, which helps to avoid mistaken inference due to disproportionate and small sample sizes. The samples sizes are indicated in Table 15-1; and the average percentage price changes are shown in Table 15-2.

The three analytic groups -- high, medium and low price reductions -- basically reflect varying intensity of the treatment effects, but do so differently for each of the six procedure

groups. For example, there is an eleven percentage point difference in the price changes between the high and low payment reduction groups for cataracts, but the difference is only five percentage points for prostatectomy.

With exception of prostatectomy, the percentage magnitude of payment reductions in the high impact category are surprisingly similar. The percentage payment reduction for prostatectomy is only three percent, whereas payment reductions range from only seven to eight percent for the others. The payment trends for the low impact category are even more similar. For all six surgical procedures, the allowable reimbursement levels for lesser-impacted carriers actually increased, although the increases were only one to three percent.

Whereas the payment reduction categories were defined from price changes for the 1987-1988 and 1986-1988 intervals (respectively, for non-cataract and cataract procedures), the observational intervals have been expanded to include 1989 for purposes of impact assessment. The estimated effects of the fee reduction are much greater and more dramatic when an additional year is allowed in distinguishing provider responses to the fee reductions. This implies that provider behavior does not adapt fully to reimbursement rate changes on a contemporaneous or same-year basis.

15.1.1 Variable Definitions

For purposes of expositional efficiency, only a limited number of variables are defined and reported herein. In conducting the episode-of-care study, however, we actually constructed and analyzed a much larger number of variables. On a selective basis, some of these additional findings will be noted in our discussion of study results. For more serious readers, the complete variable definitions and study results are reported in a separately-bound Technical Appendix to this report. This appendix also reports impact assessment results for the shorter 1987-1988 and 1986-1988 intervals.

For each of the six procedure groups included in the episode-of-care analysis, Tables 15-3 through 15-8 provide the following information by payment reduction category:

- (1) Allowed charges for the index procedure--Percentage change in charges allowed for the surgery itself.
- (2) Volume of index procedures--Percentage change in the number of index surgeries performed.
- (3) Surgical assistance--Percentage change in the proportion of index surgeries involving surgical assistance.
- (4) Additional surgery--Percentage change in the proportion of index surgeries involving an additional surgical procedure, performed incidental to the index surgery by the same surgical provider.
- (5) Period III surgery--Percentage change in the proportion of index cases with another surgery by the index surgeon during the 90-day follow up interval (i.e., Period III).
- (6) Allowed charges for surgical provider (excluding index procedure)--Percentage change in "all other" charges allowed for the index surgeon during the various observational intervals (i.e., Period I, Period II, Period III and all three combined). This represents changes in total episode payments to the surgical provider for services in addition to the index surgery itself.
- (7) Allowed charges for all other physicians for the entire episode--Percentage change in charges allowed for physicians, except the index surgeon, during the entire 121-day observational interval (i.e., Periods I, II and III combined).
- (8) Allowed charges for all physicians for the entire episode (excluding index procedure)--Percentage change in all physician charges allowed, for services other than the index procedure, during the entire 121-day observational interval.

Variables (9), (10) and (11) are basically the same as variables (6), (7) and (8), except that HER's relative value unit (RVU) scale is used to weight the service intensity. Inasmuch as the same RVU "price weights" are used in all years, the changes indicated from these variables reflect only changes in the "quantity" of services provided. The RVU-weighted comparisons essentially eliminate variation attributable to changing reimbursement rates for non-index procedures. Given the short time intervals involved in this investigation, one can reasonably assume that such price changes are exogenous to the intervention being evaluated.

15.2 Procedure-Specific Results by Payment-Reduction Category

For each procedure group, we now report and discuss the potential impact of fee reductions on the variables defined above. In reviewing these results, we emphasize the RVU-weighted results in (9), (10) and (11). We do so for the following reason. In 1987 (or 1986 in the case of cataracts), the average reimbursement rates paid for non-index procedures by

carriers in the low price reduction category were considerably lower than those paid by carriers in the high price reduction category. Over the two- or three-year study interval (i.e., 1987 to 1989, or 1986 to 1989), the reimbursement rates for non-index procedures have tended to equilibrate across carriers. This pricing trend, which is believed to be substantially exogenous and independent, tends to obscure the impact of the over-priced procedure reductions on physician practice patterns. The RVU-weighted results avoid this difficulty and basically eliminate "noise" in the analytic comparisons. We consider now the results for each surgical procedure group included in this study, beginning with cataract extractions.

15.2.1 Cataract Extractions

As seen in Table 15-3, the average allowed charge for the high impact group declined 7.3 percent over the 1986-1989 interval, compared to a 2.4 percent increase for the low impact group. Comparing these two extremes, Table 15-3 gives substantial evidence for the existence of a volume offset to the surgical fee reductions:

- the incidence of surgical assistance decreases less for the high impact group;
- the rate of increase in additional surgical procedures performed on the same date as the index procedure is greater for the high impact group;
- the rate of increase in procedures performed during the 90 day follow-up period is greater for the high impact group; and
- total allowed charges for the surgical provider, for the entire episode, are 9.5 percent higher for the high impact group, compared to a 3.5 percent drop for the low impact group.

The medium impact group, although not experiencing the same degree of price reduction, nevertheless exhibits behavior similar to the high impact group. In particular, total episode charges for surgical providers in the medium impact group were increased by 17 percent, relative, again, to the 3.5 percent decrease for the low impact group.

The total allowed charges for all physicians, tabulated in (8), gives less consistent evidence for an offset. Total allowed charges, excluding the index procedure, were increased by 15 percent for the high impact group, 31 percent for the medium impact group and 16

percent for the low impact group. While interesting, these results are less useful and potentially misleading for assessing the impact of the fee reduction. Although the allowed charges for other physicians in (8) have increased more for the low impact group, it is difficult to posit a behavioral mechanism that would have produced substitution of that magnitude, and especially to observe such response so soon after the fee reductions. We believe that this pattern is largely attributable to a regression to the mean phenomenon, with both reimbursement prices and service intensities in the low impact group rising over time to the levels in the high impact group. Our analysis of changes in practice behavior (in section 3.4) gives no indication that index providers in the high impact group are merely substituting for other physicians. With regard to cataracts, for example, the additional procedures being performed by the index ophthalmologist are not ones that other, non-ophthalmologic physicians would provide.

The RVU-weighted variables--(9), (10) and (11)--indicate the same basic pattern, albeit even more dramatically. For the surgical providers, the total episode results in (9) indicate an 18 percentage point differential between the rates of service intensity change in the high and low impact groups. Again, a somewhat larger differential is shown between the medium and low impact groups.

The rates of change in index procedure volume in (2) show a lower rate of increase in volume for the high impact group, compared to the low impact group (5.7% vs. 12.4%). Much the same pattern was found for the other five procedure groups included in the episode-of-care study. However, since the assessment of volume effects was not the express interest of this chapter, such results will not be emphasized in reporting the episode-of-care results. The analysis in Chapter 14 gives a much more dependable indication of the impacts on index procedure volume.

While not shown in Table 15-3, additional results reported in the Technical Appendix show that the average RVU weight for cataract procedures increased only two to three percent over the 1986-1989 interval. Thus, we find little indication of procedure upcoding. The average RVU values for the other five procedure groups indicated even less meaningful changes.

Other results available from the Technical Appendix show that the trends in second cataract surgery vary importantly by payment reduction category. During Period II (i.e., the

day of surgery itself), the RVU-weighted intensity of second cataract procedures increased 62 percent in the high impact group, but it decreased 66 percent in the low impact group. Similarly, in Period III (i.e., the 90-day interval subsequent to surgery), the RVU-weighted intensity of second cataracts increased 37 percent and declined four percent, respectively, in the two groups. Section 15.4 gives further evidence on the differences in second cataract usage.

Total Hip Replacement. The results, in Table 15-4, indicate that OBRA-87 produced a ten percentage point payment differential between the high and low impact groups for this procedure group. Over the 1987-1989 interval, the average allowed charge for hip replacement decreased 5.3 percent in the high impact group, but increased 4.9 percent in the low impact group.

Unlike cataracts, the total episode results for this procedure gives only weak evidence for the existence of an offset. Consistent with the offset hypothesis, total episode charges for the surgical provider increased at a modestly higher rate in the high impact, 11.6 percent compared to an increase of 10.1 percent in the low impact group. The RVU-weighted comparison indicates a somewhat larger differential, 8.8 and 5.7 percent, respectively. These differences, however, are not statistically significant.

For the high impact group, compared to the low impact group, Table 15-4 indicates a much larger rate of increase in additional surgery during the same day. However, we also see a much lower rate of increase in surgery during the 90-day followup interval. The rate of surgical assistance declines less rapidly in the high impact group.

Total Knee Replacement. This procedure group gives no indication of an offset. Comparing the high and low impact groups (see Table 15-5), we find the following:

- the incidence of surgical assistance increased more in the low impact group;
- the incidence of additional surgery, during the same time as the index surgery, increased dramatically more in the low impact group;
- the rate of surgery during the 90 day follow-up period increased somewhat more for the high impact group;
- total episode charges for the surgical provider increased only two percentage points more for the high impact group; and
- the RVU-weighted "quantity" of all index provider services increased one percentage point less for the high impact group.

The evident lack of impact may be attributed, in part, to having a less robust "treatment" or intervention. Compared to payment differentials of approximately ten percentage points for cataracts and hip replacements, the price impact on knee replacement is only six percentage points. Over the 1987-1989 interval, average charges for the index procedure decreased 4.4 percent in the high impact group and increased 1.6 percent in the low impact group.

CABG Surgery. Like cataracts, this procedure group exhibits a substantial and significant offset effect. As seen in Table 15-6, over the 1987-1989 interval, the average allowed charge for this procedure decreased 5.6 percent in the high impact group and increased 3.0 percent in the low impact group. Thus, the surgical fee reductions produced roughly a nine percentage point price differential in this procedure group.

The apparent effects on surgical assistance and Period III surgery are neither dramatic nor significant, although some additional same-day surgery is indicated. Nevertheless, total episode charges for the surgical provider increased 4.5 percent in the high impact group, but decreased 14.3 percent in the low impact group. The total RVU-weighted service intensities increased 8.4 percent and decreased 11.0 percent, respectively. The latter suggests that a combined 19 percentage point differential in the quantity of nonindex care provided to index patients may be attributed to the surgical fee reductions. As further reported in the Technical Appendix, total allowed charges for other cardiac procedures, performed on the same day, increased 23 percent in the high impact group and decreased 17 percent in the low impact group.

Upper GI Endoscopy. This procedure group (see Table 15-7) gives only modest evidence for an offset effect. Focusing on the index provider's RVU-weighted service intensity for the entire episode, we find that the rate of change is only 2.5 percent points higher in the high impact group, compared to the low impact group. This difference is not statistically significant. On the other hand, if one looks at the RVU-weighted service intensity in Period III, we find a pattern which is consistent with the offset hypothesis--namely that, Period III services increase 10.6 percent for the high impact group and decrease 2.1 percent for the low impact group. In particular, the relative incidence of Period III surgery is considerably increased in the high impact group. This differential, however, is largely mitigated by the extraordinary 31.1 percent increase service intensity seen for the low impact group in Period

II. Thus, on balance, we must conclude that no meaningful evidence for an offset is shown for endoscopy.

Prostatectomy. This procedure group also gives no evidence of an offset to the surgical fee reduction. Quite the contrary, as seen in Table 15-8, allowed charges and RVU-weighted service volumes increased at a higher rate for the low impact group. Total episode service volume for the surgical provider increased only 7.0 percent for the high impact group, compared to a 12.3 percent increase for the low impact group. This difference is not statistically significant. Nevertheless, additional same-day surgery and Period III surgery also show the same pattern.

Prostatectomy is a comparatively less expensive procedure, and it unquestionably accounts for a smaller proportion of surgeon income than cataract and CABG procedures. Also, the treatment effect for prostatectomy is less robust, with only a six percentage point price differential indicated from the high vs. low impact group comparisons. Consequently, it was anticipated that this procedure group would be less likely to elicit a provider response to the fee reduction. Indeed, the pattern seen in Table 15-8 may indicate what might have been expected for other procedures in the absence of the fee reduction intervention. Consider the following.

In the absence of the fee reductions, one tends to assume that the service volume or intensity would have increased at the same rate in all three price reduction groups. However, that may not be the appropriate assumption about what otherwise would have pertained. For all six procedure groups, the 1987 (or 1986) service levels in the low impact group were lower than those in the high impact group. Thus, our finding for prostatectomy--namely, that the nonindex service intensity per episode is rising faster in the low impact group--may reflect a regression to the mean phenomenon. The service intensity for the low impact group appears to be gravitating or rising to the same absolute level as the high impact group. In the absence of the fee reductions, it is possible that we would have seen similar patterns for cataracts, total hip replacement, total knee replacement and CABG surgery. If so, the program impacts may be substantially understated from our approach to measuring offsets.

It is not easy, however, to establish the appropriate assumption about what otherwise would have happened. Indeed, it probably can not be done without also looking at the experience for surgical procedures not impacted by the fee reductions.

15.3 Estimation of the Offset Effects

Only two of the six procedure groups included in this study--cataract extractions and CABG surgery--give significant evidence for the existence of a service volume offset to the fee reductions. Our findings with respect to the four other surgical procedures included in this study are not statistically significant. We now ask the question, how important are the offsets indicated from our findings? In an effort to answer that question, we perform the following calculations which basically focus on the service intensity differences between the high and low impact groups in measuring the importance of the offsets, if any.

For each procedure group, we shall assume that the fee reductions are responsible for the entire price trend differential between the high and low impact groups. For example, as seen in Table 15-3, there is a 9.7 percentage point differential between rates of change in the average allowed for cataracts, i.e., the percentage point differential between -7.28% for the high impact group and +2.41% for the low impact group. This differential implies a \$169 reduction in the allowed amount for the group most affected by the payment reductions -- calculated as 9.7 percent of the 1986 average allowed for cataracts in the high impact group.

We also assume that, for the surgical provider, the total episode differences in RVU-weighted service intensity trends between the high and low impact groups can be attributed to the fee reductions. Table 15-3 indicates a 18.1 percentage point differential between the trends in total episode service intensity for the surgeon, i.e., the percentage point differential between +18.7% for the high impact group and +0.6% for the low impact group. This differential suggests that--after controlling for the arguably exogenous changes in actual reimbursement rates--cataract surgeons in the high impact group billed an additional \$64 worth of services -- calculated as 18.1 percent of the 1986 average allowed for the entire episode, excluding the index procedure, in the high impact group. Thus, our results indicate that surgeons made up \$64, or 38 percent, of the \$169 fee reduction for cataracts through other billings to the same patients.

The above estimates and similar results for the five other procedure groups are summarized in Table 15-9. Significant results are shown in bold. As can be seen, all of the fee impact estimates in columns (1) and (2) are significantly different from zero. However, the

offset estimates in columns (3) and (4) are significant only for the cataract and CABG procedure groups. The percentage offsets estimated for these two groups in column (5) are 38 percent and 30 percent, respectively. The average of these two offset estimates is 34 percent. The simple average for all six procedures is 12.5 percent. However, if you weight the procedure-specific values by procedure volume and the average allowable reimbursement for each, the average is 24.7 percent. This latter estimate represents the average per episode offset involved on a programwide basis, in terms of total Medicare reimbursement for all six procedures.

This estimation begs a number of important questions. One of these concerns the behavioral adjustment process involved. In our data, insufficient time may have elapsed for the surgical providers to complete their adaptation to the surgical fee reductions. Also, as discussed above, some narrowing of the fee differentials may have taken place anyway in the absence of the fee reduction legislation. If so, the fee impacts are overstated in Table 15-9, and the offset percentages are understated. This question about what otherwise would have happened, as well as our question about the longer-run adaptation, can not be answered from this study.

15.4 Changes in Practice Behavior of the Index Providers--Cataracts and CABGs

For the two procedure groups indicating significant offset effects, cataracts and CABGs, we seek in Tables 15-10 and 15-11, respectively, to distinguish the procedures responsible for the offsets. In these tables, we identify the procedures and procedure categories which account for at least a one unit difference, in absolute value, between the high and low impact groups in their service intensity trends. Consider, for example, the second cataract procedure in Table 15-10. In column (1), we see that the RVU-weighted volume of such procedures -- equivalent to 1987 reimbursement dollars -- in the high impact group increased by 25.4 units over the 1986-1989 interval. In column (2), we see that the volume decreased by 11.4 units in the low impact group. Thus, as depicted in the right-hand column, the 1986-1989 trend difference between the two groups is 36.8 units. This suggests that the second cataract procedure has contributed approximately \$37 to the \$64 offset estimated for cataract extractions in Table 15-9. Other results for the two procedure groups are discussed separately below.

Cataract Extractions. In the aggregate, the procedures included in Table 15-10 account for approximately \$60, or 94 percent, of the \$64 offset estimated for cataracts. If one also includes discission or removal of secondary membranous cataract, additional cataract procedures actually contribute about \$42 (\$37 plus \$5) to the \$64 offset. That does not mean, however, that additional cataracts were responsible for that proportion of the offset. Because some of the "differences" in Table 15-10 are negative, it takes more than 64 dollars worth of positive differences to yield a \$64 net difference.

In general, the procedures responsible for the cataract offset, and most especially the additional cataract procedures themselves, are often discretionary and subject to substantial practice variation. Keratoplasty (reconstruction or transplantation of the cornea) and fistulization of sclera for glaucoma (cutting a hole in the sclera to relieve pressure inside the eye) are generally unrelated to cataract surgery but also involve considerable discretion on the part of the ophthalmologist.

CABG Surgery. In the aggregate, the procedures included in Table 15-11 account for approximately \$102, or 84 percent, of the \$122 offset estimated for CABG surgery in Table 15-9. A much larger number of procedures are included in this table, and the interpretation is accordingly more difficult. In particular, we have some concern that the differences indicated could reflect changes in billing rather than practice behavior. It is possible that some index providers are now billing related procedures that were not formerly billed separately (i.e., fragmentation of billing). Also, there may be some shifting between the billing codes; for example, procedures formerly billed as miscellaneous cardiac procedures may have been more recently billed as valve procedures or something else.

Our results further reflect the impact of technical change on practice behavior. We see, for example, that postinfarction myocardial procedures have declined in both the high and low impact groups, albeit to a somewhat lesser extent in the high impact group. This undoubtedly reflects the findings from recent clinical trials which have not supported the advantages of such early treatment.

Some of the procedures accounting for the CABG offset--e.g., valve procedures, second CABG, and thoracic aortic aneurysm -- involve very substantial additional risk to the patients.

Others such as cardiac catheterization are substantially discretionary. Based on this study, however, we can not evaluate whether the high or low impact practice trends are more appropriate.

15.5 A Supplemental Test of the "Offset" Results

A large-scale econometric study, which also examines the experience for surgical procedures not impacted by the surgical fee reductions, may be helpful in answering unresolved questions and should yield more precise estimates of the pure offset effects. While a serious econometric investigation was not conducted as part of this project, we used the available data to conduct a simple multivariate test and thereby seek additional, corroborating evidence for the offset effects estimated above.

For each procedure group included in the episode-of-care analysis, we estimated the following linear model:

$$\Delta Q = \beta_0 + \beta_1 * \Delta P + \beta_2 * Q^{87}$$

where

$$\Delta Q = (Q^{89} - Q^{87}) / Q^{87},$$

$$\Delta P = (P^{89} - P^{87}) / P^{87},$$

P^{87} and P^{89} = the average allowed surgical charges in 1987 and 1989, respectively, and

Q^{87} and Q^{89} = the RVU-weighted values of other services provided, on a total episode basis, by the index provider in 1987 and 1989, respectively.

The offset hypothesis suggests that ΔQ will vary inversely with ΔP . In other words, those surgical providers subject to the largest price reductions, or lowest price increases, are predicted to exhibit the greatest increases in billing of non-index procedures. The second independent variable, Q^{87} , is included to control for a potential regression to the mean phenomenon--namely, the possibility, as suggested above, that the non-index service intensity in the lower impact groups is rising faster and gravitating to the same level as the high impact group. This would imply a negative coefficient for the Q^{87} variable; that is, if the base level is low, the increase will be greater. For the cataract procedure, of course, the base year is 1986.

The results for all six procedure groups are reported in Table 15-12. Although the percentage of variation explained by these rudimentary models is never more than 26 percent, all six of the models yield significant F values. Also, the base-year "Q" variables are highly significant (.05 level or better) in all six models; and the coefficients estimated for this variable are uniformly negative as predicted by the regression to the mean hypothesis.

The ΔP variable--our proxy for the fee reduction intervention--is significant in only two models. It is significant at the .05 level or better for both cataract extraction and CABG surgery; and the coefficient estimates are negative as implied by the offset hypothesis. The ΔP coefficient estimates for the four other procedure groups are highly insignificant, with only one procedure having a coefficient estimate even as large as its standard error.

The multivariate test clearly supports and substantially validates the offset findings obtained above from our comparison above of the high and low impact groups. The same two procedure groups, cataracts and CABGs, indicate significant offsets.

In Table 15-13, we have calculated the offset percentages implied by the multivariate results, and we compare those estimates to the estimates obtained from the comparisons reported in Table 15-9. The multivariate estimate of the offset percentage for cataract extraction is somewhat lower than the comparison-based estimate; and that obtained for CABG surgery is somewhat higher. Nevertheless, the magnitudes are broadly similar, and the two-procedure averages for the two estimation approaches are nearly the same (32 percent and 34 percent, respectively). The offset percentages estimated from the multivariate model for other procedure groups bear no discernible relationship to estimates from the comparisons. This further attests to the insignificance and essentially random nature of those results.

Finally, one may ask why cataracts and CABGs would show an offset but not the four other procedure groups? We can not give a definitive answer to that question, but we offer the following hypothesis. The cataract and CABG procedures may have elicited stronger and quicker practice responses because those procedures are relatively more important as a percentage of income to the providers involved. As reported by Joe Escarce (1989), cataract

surgery accounts for 49 percent of Medicare revenues to ophthalmologists, and CABG surgery accounts for 43 percent of Medicare revenues to cardiothoracic surgeons. By comparison, the four other procedures included in this study account for an average of only 19 percent of Medicare revenues to the principal specialty associated with each. Thus, our results are consistent with the hypothesis that an intervention impacting a greater proportion of provider revenues is likely to elicit a larger and more immediate offset response.

TABLE 15-1

PROCEDURE GROUP SAMPLE SIZES

	PROCEDURE SAMPLE SIZES BY PAYMENT REDUCTION CATEGORY					
	HIGH		MEDIUM		LOW	
	<u>1987^a</u>	<u>1989</u>	<u>1987^a</u>	<u>1989</u>	<u>1987^a</u>	<u>1989</u>
Cataract extraction	8,526	9,012	9,322	11,036	8,252	9,277
Total hip replacement	745	700	737	732	697	684
Total knee replacement	666	776	682	776	690	848
CABG surgery	961	1,090	943	1,192	943	1,098
Upper GI endoscopy	6,861	7,846	6,255	6,278	6,683	8,246
Prostatectomy	2,784	2,370	2,487	2,173	2,770	2,527

^aExcept 1986 for cataract extraction.

TABLE 15-2

AVERAGE PERCENTAGE PRICE CHANGES, 1987-1988^a

	<u>PAYMENT REDUCTION CATEGORY</u>			<u>Entire Sample</u>
	<u>High</u>	<u>Medium</u>	<u>Low</u>	
Cataract extraction	-8.2%	-2.9%	2.3%	-2.9%
Total hip replacement	-6.8	-1.8	3.3	-1.8
Total knee replacement	-6.7	-2.5	1.1	-2.7
CABG surgery	-7.1	-3.2	2.8	-2.5
Upper GI endoscopy	-6.5	-1.0	2.5	-1.7
Prostatectomy	-3.4	0.5	1.7	-0.5

^aExcept 1986-1988 for cataract extraction.

TABLE 15-3

EPISODE OF CARE SUMMARY FOR CATARACT EXTRACTION, 1986-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-7.28%	-1.35%	2.41%
2. Volume of index procedures	5.7	18.4	12.4
3. Surgical assistance	-20.8	-45.0	-67.3
4. Additional surgery	29.4	6.4	2.7
5. Period III surgery	34.2	34.7	14.8
6. Allowed charges for index provider (excluding index procedure)			
Period I	-5.5	8.6	-5.5
Period II	-11.6	-10.0	-22.7
Period III	31.3	33.6	5.4
TOTAL EPISODE	9.5	17.3	-3.5
7. Allowed charges for all other physicians for the entire episode	3.6	31.2	22.8
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	15.0	31.4	16.0
9. RVU weights for index provider services (excluding index procedure)			
Period I	11.8	29.7	14.1
Period II	5.9	-7.0	-25.4
Period III	31.9	34.0	3.9
TOTAL EPISODE	18.7	23.9	0.6
10. RVU weights for all other physician services for the entire episode	0.9	19.2	10.3
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	13.9	25.0	9.9

TABLE 15-4

EPISODE OF CARE SUMMARY FOR TOTAL HIP REPLACEMENT, 1987-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-5.3%	-1.38%	4.89%
2. Volume of index procedures	-6.0	-0.7	-1.9
3. Surgical assistance	-3.7	9.8	-8.9
4. Additional surgery	28.3	15.8	-3.5
5. Period III surgery	-13.8	-5.3	34.5
6. Allowed charges for index provider (excluding index procedure)			
Period I	-20.5	17.5	-3.5
Period II	20.9	-2.9	10.7
Period III	22.8	16.7	17.4
TOTAL EPISODE	11.6	7.6	10.1
7. Allowed charges for all other physicians for the entire episode	0.2	16.3	11.6
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	6.9	10.5	15.8
9. RVU weights for index provider services (excluding index procedure)			
Period I	-25.2	4.1	-7.2
Period II	18.8	-5.7	4.0
Period III	16.7	20.8	15.0
TOTAL EPISODE	8.8	5.4	5.7
10. RVU weights for all other physician services for the entire episode	-1.2	15.0	13.7
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	8.5	12.9	16.0

TABLE 15-5

EPISODE OF CARE SUMMARY FOR TOTAL KNEE REPLACEMENT, 1987-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-4.41%	-1.05%	1.65%
2. Volume of index procedures	16.5	13.8	22.9
3. Surgical assistance	1.8	16.5	11.7
4. Additional surgery	-1.4	17.2	68.2
5. Period III surgery	-2.4	27.6	5.8
6. Allowed charges for index provider (excluding index procedure)			
Period I	-3.9	31.3	-0.1
Period II	10.8	9.0	7.1
Period III	0.8	-3.9	-1.8
TOTAL EPISODE	4.2	6.3	2.4
7. Allowed charges for all other physicians for the entire episode	0.3	23.6	23.6
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	4.4	17.3	18.6
9. RVU weights for index provider services (excluding index procedure)			
Period I	-8.6	15.6	0.0
Period II	2.6	11.9	5.9
Period III	3.5	-9.8	-1.2
TOTAL EPISODE	0.8	2.8	2.0
10. RVU weights for all other physician services for the entire episode	0.0	14.1	17.5
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	1.9	13.7	14.1

TABLE 15-6

EPISODE OF CARE SUMMARY FOR CABG SURGERY, 1987-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-5.65%	-1.89%	3.05%
2. Volume of index procedures	13.4	26.4	16.4
3. Surgical assistance	0.2	20.8	3.6
4. Additional surgery	26.0	20.0	18.4
5. Period III surgery	8.9	21.1	12.7
6. Allowed charges for index provider (excluding index procedure)			
Period I	-15.8	3.4	-12.6
Period II	5.0	10.6	-13.6
Period III	19.9	23.8	-18.5
TOTAL EPISODE	4.5	11.4	-14.3
7. Allowed charges for all other physicians for the entire episode	5.9	9.2	6.9
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	6.2	6.8	4.9
9. RVU weights for index provider services (excluding index procedure)			
Period I	-14.8	4.0	-16.2
Period II	11.0	14.4	-8.2
Period III	8.0	24.4	-19.9
TOTAL EPISODE	8.4	14.4	-11.0
10. RVU weights for all other physician services for the entire episode	1.9	6.6	4.3
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	7.8	7.9	5.6

TABLE 15-7

EPISODE OF CARE SUMMARY FOR UPPER GI ENDOSCOPY, 1987-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-6.35%	0.30%	2.82%
2. Volume of index procedures	14.4	0.4	23.4
3. Surgical assistance	36.3	-18.8	-16.7
4. Additional surgery	11.1	4.0	25.2
5. Period III surgery	9.0	0.8	-5.6
6. Allowed charges for index provider (excluding index procedure)			
Period I	3.6	10.5	2.7
Period II	14.6	7.6	35.6
Period III	9.5	4.2	1.9
TOTAL EPISODE	8.9	6.6	9.4
7. Allowed charges for all other physicians for the entire episode	2.7	8.9	17.8
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	7.1	11.7	21.0
9. RVU weights for index provider services (excluding index procedure)			
Period I	1.9	7.6	-1.8
Period II	10.9	3.7	31.1
Period III	10.6	2.1	-2.1
TOTAL EPISODE	8.3	3.9	5.8
10. RVU weights for all other physician services for the entire episode	-0.4	4.0	13.8
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	4.3	6.6	16.2

TABLE 15-8

EPISODE OF CARE SUMMARY FOR PROSTATECTOMY, 1987-1989

	PERCENTAGE CHANGE BY PAYMENT REDUCTION CATEGORY		
	High	Medium	Low
1. Allowed charges for index procedure	-4.55%	0.97%	1.58%
2. Volume of index procedures	-14.9	-12.6	-8.8
3. Surgical assistance	-18.0	14.4	-23.1
4. Additional surgery	9.3	-1.9	12.6
5. Period III surgery	-5.4	12.0	-0.7
6. Allowed charges for index provider (excluding index procedure)			
Period I	9.0	28.8	21.6
Period II	8.9	12.9	26.2
Period III	10.5	16.7	17.5
TOTAL EPISODE	9.4	22.6	21.4
7. Allowed charges for all other physicians for the entire episode	13.4	14.6	18.5
8. Allowed charges for all Part B services for the entire episode (excluding index procedure)	13.9	15.5	20.8
9. RVU weights for index provider services (excluding index procedure)			
Period I	5.2	12.8	11.0
Period II	11.4	2.9	17.3
Period III	6.8	1.5	10.4
TOTAL EPISODE	7.0	7.6	12.3
10. RVU weights for all other physician services for the entire episode	13.3	9.7	16.1
11. RVU weights for all Part B services for the entire episode (excluding index procedures)	13.0	10.8	17.8

TABLE 15-9

COMPARISON OF "HIGH" VERSUS "LOW" IMPACT GROUPS, 1987-1989^a

	<u>ESTIMATED FEE IMPACT</u>		<u>ESTIMATED "OFFSET"</u>		(5) "Offset" Percentage
	(1) <u>Percent</u>	(2) <u>Amount</u>	(3) <u>Percent</u>	(4) <u>Amount</u>	
Cataract extractions	-9.7%	\$-169	18.1	\$64	37.9%
Total hip replacement	-10.2	-293	3.1	9	3.1
Total knee replacement	-6.1	-160	-1.2	-3	-2.1
CABG surgery	-8.7	-405	19.4	122	30.2
Upper GI endoscopy	-9.2	-34	2.5	7	21.1
Prostatectomy	-6.1	-78	-5.3	-12	-15.0

^aExcept 1986-1989 for cataract extraction.Note: Significant values bolded.

TABLE 15-10

CHANGES IN THE INDEX PROVIDER'S BILLING OF SELECTED NONINDEX PROCEDURES,
CATARACT, 1986-1989

<u>Procedure</u>	<u>RVU-WEIGHTED CHANGE BY PAYMENT REDUCTION CATEGORY</u>		
	<u>(1) High</u>	<u>(2) Low</u>	<u>(1)-(2) DIFFERENCE</u>
Second cataract	25.42	-11.38	36.80
Keratoplasty	7.40	-0.76	8.16
Fistulization of sclera for glaucoma with trabeculectomy	6.04	0.60	5.44
Discission or removal of secondary membranous cataract	16.26	10.84	5.42
Posterior segment -- vitreous	-0.79	-5.37	4.58
Iridotomy by photocoagulation	2.86	0.24	2.62
Anesthesia for lens surgery	2.34	0.31	2.03
Trabeculotomy	0.88	-0.72	1.60
Plastic repair of canaliculi	1.09	0.00	1.09
Ophthalmic ultrasound	8.42	10.67	-2.25
Intraocular lens purchase	-30.87	-28.60	-2.27
Comprehensive visit	<u>-0.24</u>	<u>3.05</u>	<u>-3.29</u>
TOTAL	38.81	-21.12	59.93

TABLE 15-11

CHANGES IN THE INDEX PROVIDER'S BILLING OF SELECTED NONINDEX PROCEDURES, CABG, 1987-1989

<u>Procedure</u>	<u>RVU-WEIGHTED CHANGE BY PAYMENT REDUCTION CATEGORY</u>		
	<u>(1) High</u>	<u>(2) Low</u>	<u>(1)-(2) DIFFERENCE</u>
Valve procedures	22.77	-15.01	37.78
Thoracic aortic aneurysm	18.74	2.49	16.25
Cardiac catheterization	4.18	-10.83	15.01
CABG, surgical assistance	0.11	-11.53	11.64
Second CABG	1.85	-9.64	11.49
Lung and pleura -- excision	3.40	-3.54	6.94
Hospital care	2.92	-3.89	6.81
Postinfarction myocardial procedures	-16.04	-22.19	6.15
Septal defect	3.59	-2.12	5.71
Exploration	2.02	-3.46	5.48
Patent ductus arteriosus; ligation	3.10	0.00	3.10
Sternum procedures	5.29	2.39	2.90
Assembly/operation of pump with oxygenator	-2.86	-5.31	2.45
Excision of intracardiac tumor	0.00	-2.22	2.22
Pericardium procedures	0.68	-1.32	2.00
Electrocardiogram interpretation	-0.13	-2.06	1.93
Endoscopy with therapeutic aspiration of tracheobronchial tree	1.59	-0.30	1.89
Mediastinum	-0.03	-1.56	1.53
Wounds of the heart and great vessels	0.35	-1.15	1.50
Pulmonary artery embolectomy	-1.90	0.00	-1.90
Angiocardiology	0.00	2.01	-2.01
Aneurysm repair	2.93	5.35	-2.42
Blood vessel repair	-1.95	0.76	-2.71
Anesthesia	-4.93	-0.76	-4.17
Consultations	-1.67	2.73	-4.40
Unrelated surgery	-5.32	-0.71	-4.61
Vascular injection procedures	-3.53	2.69	-6.22
Miscellaneous cardiac procedures	<u>-6.09</u>	<u>5.78</u>	<u>-11.87</u>
TOTAL	29.07	-73.40	102.47

TABLE 15-12

 ΔQ -REGRESSION MODELS, 1987-1989^a

REGRESSION COEFFICIENTS BY PROCEDURE GROUP ^b						
Independent Variable	Cataract Extraction	Total Hip Replacement	Total Knee Replacement	CABG Surgery	Upper GI Endoscopy	Prostatectomy
Constant	54.0 (11.3)	53.4 (19.1)	44.3 (14.0)	23.5 (11.3)	39.0 (8.36)	36.5 (12.5)
ΔP	-1.06** (0.46)	0.844 (0.995)	-1.03 (0.84)	-1.88** (0.75)	0.036 (0.369)	-0.177 (0.595)
Q	-0.0996*** (0.0273)	-0.118** (0.0485)	-0.114*** (0.035)	-0.0293** (0.0130)	-0.101*** (0.0251)	-0.0963** (0.0461)
Summary Statistics						
R-square	.24	.14	.23	.23	.26	.08
Adjusted R-square	.21	.10	.20	.19	.23	.05
F value	7.44	3.34	6.26	5.73	8.47	2.18

*Significant at .10 level or better.

**Significant at .05 level or better.

***Significant at .01 level or better.

^aExcept 1986-1989 for cataract extraction.^bStandard errors in parentheses.

TABLE 15-13

TWO ALTERNATE ESTIMATES OF THE "OFFSET" PERCENTAGES

<u>Procedure Group</u>	<u>ESTIMATED "OFFSET" PERCENTAGE</u>	
	<u>Heuristic Comparisons</u>	<u>Multivariate Model</u>
Cataract extraction	37.9%	27.3%
Total hip replacement	3.1	-12.4
Total knee replacement	-2.1	15.9
CABG surgery	30.2	35.9
Upper GI endoscopy	21.1	-3.7
Prostatectomy	-15.0	4.2

Note: Significant values bolded.

16.0 DESIGN OF A PROVIDER-LEVEL STUDY

The analyses above -- in Chapters 14 and 15 -- examine the impact of overpriced procedure reductions on two criteria, (1) the volume of overpriced procedures and (2) the volume and cost of other services provided in association with the overpriced procedures. A final task was to design, but not actually implement, a study that would investigate still other impacts on physician practice behavior. The nature of *individual* physician response to the overpriced procedure reductions is unquestionably the crux of the problem. However, as discussed herein, a provider-level study of individual physician responses to the fee reductions confronts significant data limitations.

Ideally, one would pursue a provider-level analysis which observes how the practice patterns of individual physicians change in response to their specific or personal fee reductions. Such a provider-level analysis would enable us to more reliably specify and estimate the behavioral relationship between fee reductions and changes in procedure volume. For example, a physician who relies on an overpriced procedure for 50 percent of his or her practice revenue may be expected to respond very differently to a given fee reduction than one who derives only five percent of revenues from the procedure.

Provider-level claims data would, in addition, permit analysis of changes in the procedure mix at the complete practice level. For example, we would like to know to what extent surgical practices reduce the number of overpriced procedures, but increase the number of close substitutes not subject to fee reductions? An example would be a thoracic surgeon who substitutes PTCA for CABG surgery.

Also, with sufficient data, a provider-level analysis could detect changes in the payor mix. For example, we would like to know to what extent physicians switch their practices and shift costs from Medicare to non-Medicare patients? Have ophthalmologists, for example, responded to the fee reduction by providing more cataract surgery to non-Medicare patients?

16.1 Data Limitations

The value of pursuing a provider-level analysis is unfortunately mitigated by two key data problems:

- (1) it's not possible to distinguish the services that individual physicians provide to non-Medicare patients; and
- (2) it is extremely difficult to distinguish the services that individual physicians provide to Medicare patients.

Each of these problems is discussed below.

First, there is no large-scale claims data base, or other data source, that captures the requisite provider-level information on services provided to non-Medicare patients.

Non-Medicare services are billed to a multitude of claims payers, including Medicaid, Blue Cross/Blue Shield, commercial insurers, HMOs and independent third-party administrators. It is not unusual for a medical practice to bill 30 or more different third parties in a given year. Furthermore, services provided to the uninsured are not captured in any claims payment system. Apart from a special study, it is not feasible to obtain provider-specific information on the universe of care provided to non-Medicare patients.

While not impossible, it is also difficult, using historical data, to obtain dependable information on the universe of care provided to Medicare patients on a provider-specific basis. Until recently, the Part B carriers in most states used a combination of group and individual-specific provider numbers for Medicare billing purposes. This presents two different, but related difficulties. One, the services billed from group practices cannot be associated with specific physicians. The automated Medicare claims data indicate only that a procedure was performed by someone within the group practice. Two, many physicians bill services using more than one provider number. For example, a physician may bill some services using a physician-specific provider number (i.e., on a solo practice basis) but bill others through a hospital-based group practice or clinic. Both problems--(1) multiple physicians billing on the same provider number and (2) individual physicians billing on multiple provider numbers--make it extremely difficult to develop a composite profile of Medicare provider-level practice patterns, using historical claims data.* Nevertheless, as discussed below, the available Medicare data may permit limited provider-level analyses.

*Eventually, Unique Provider Identification Numbers (UPINs) will be recorded in Medicare's National Claims History (NCH); and provider-level analysis using 100 percent claims files will become considerably less problematic.

16.2 Assessment of the Medicare Data Alternatives

A provider-level analysis can be conducted from either of two major Medicare claims data bases:

- CHER's multistate data; or
- the BMAD five (5) percent provider files.

The advantages, disadvantages and complexities of using either alternative are considered below.

16.2.1 CHER's Multistate Data

As described in Chapter 2, CHER has acquired 100 percent Part B data for ten states, beginning in 1986 and continuing through 1989. However, the quality and coverage of CHER's provider information is highly variable across the ten states and across years within each state. A provider-level analysis would be easiest and least expensive in those states for which we already have relevant provider information and for which the provider numbers have not changed over time.

Alabama and Kansas present the most attractive study candidates. Both states have conveniently maintained unique provider numbers on their automated Part B bills. Thus, for these two states only, we can reliably distinguish **all** of the Medicare services provided by individual physicians.

For other states, the provider files variously provide information on (1) provider types (e.g., solo versus group practice) and (2) the numbers of physicians in group practices. We have little or no confidence in the latter information, however, inasmuch as the values vary improbably over time. Furthermore, we know that the carriers have had little motivation to maintain accurate group size information. Thus, for group practices, changes in procedure volume over time may simply be attributable to unreported changes in the numbers

of physicians in each practice. In addition, it is particularly difficult to track carrier changes in provider coding for group practice billing and reimbursement.

On the other hand, the provider-type information is thought to more reliably discriminate providers practicing on a solo practice basis. Thus, if a solo practitioner's Medicare revenues are not unreasonably small and if they do not exhibit extreme year-to-year volatility, we may surmise that the physician is substantially dedicated to solo practice. That is, one can infer that the practice's Medicare revenues represent substantially all of the physician's Medicare activity. Alternatively, it may be feasible to restrict the study to providers with only a single "solo practice" provider number as reported on MPIER.

The provider information available from other states in our multistate universe can be summarized as follows. CHER has provider files distinguishing solo practice physicians for four additional states--Arizona, Oklahoma, Oregon and Washington. Although we also have provider information for Georgia and New Jersey, the provider codes in those two states have changed. Thus, in those two states, it would be necessary to obtain a "cross walk" between the present and former provider codes. CHER does not currently have provider information for Connecticut, Pennsylvania and Kansas City. However, provider information is available from the carriers.

16.2.2 BMAD Provider Files

Conducting a provider-level analysis from the BMAD provider files confronts the same difficulties (e.g., inability to measure group size) as indicated above with respect to the multistate data. Thus, any provider-level analysis conducted from this data must also focus on solo practice physicians.

The BMAD provider files, however, present a further, significant problem. There appears to have been considerable inconsistency over time in carrier selection of the five (5) percent provider sample. As a diagnostic test, we examined the 1986 and 1989 BMAD provider files. We found that only 51.2 percent of the solo practice physician provider IDs included in the 1986 file were also included in the 1989 file. The match rates were generally similar by specialty, but, as expected, the match rates varied substantially by carrier (from 0.0 to 77.8 percent). If one also requires that specialty codes match, the overall match rate falls to 50.3 percent.

A total of 6,229 solo practice physicians were matched on provider ID and specialty, as well as provider type. These physicians were distributed across 33 different carriers, as shown in Table 16-1. However, just three "states" (New York, Texas and Florida) account for 46 percent of the matches. In Table 16-2, the solo practice matches are distributed by specialty. (Although many of the specialties are not relevant to this study, we thought that HCFA would like to see the entire distribution.) As examples, this table indicates that we have 320 ophthalmologists, 438 general surgeons, and 254 orthopedic surgeons, but only 68 thoracic surgeons.

The information above is merely intended to be illustrative. If, for example, one were looking for BMAD matches over the shorter 1987-1989 interval, the available sample size would almost certainly be increased. Thus, the BMAD alternative could be even more attractive than these data suggest.

16.3 Suggested Study Design

In conclusion, a two-pronged strategy for conducting a provider-level analysis of the surgical fee reductions seems feasible:

- (1) use CHER's data for Kansas and Alabama to distinguish effects on both solo and group practice providers in those states; and
- (2) use the BMAD provider files to distinguish the effects on a larger universe of solo practice providers.

Finally if the results from (1) and (2) above were sufficiently robust, one could perhaps combine them with other provider distributional parameters (e.g., percent of care provided by group practices) from BMAD to generalize or extrapolate study findings to the entire country.

Consider now some additional study design specifications. For each physician, the magnitude or importance of the fee reduction, as an impetus to changing practice behavior, varies directly with two physician-specific practice parameters:

- (1) the physician's Medicare practice share (e.g., percent of practice revenues from Medicare patients); and

- (2) the importance of the overpriced procedure to the physician's Medicare practice (e.g., the percent of Medicare revenues attributable to the overpriced procedure).

Unfortunately, no provider-specific information are available on (1), the physician's Medicare practice share. As already discussed, we have no information on provider practice patterns and revenues relative to non-Medicare patients. Nevertheless, national survey data on average practice size by specialty could be used to calculate a proxy for this variable.

In the first study proposed above (i.e., the one using data from Kansas and Alabama), the value of (2), the importance of the overpriced procedure to the physician's Medicare practice, could be calculated precisely. In the second study (i.e., the one using BMAD data), it would be measured accurately only to the extent that one can distinguish providers who practice predominantly in the solo practice mode.

If sample sizes permit, it would be desirable to focus the study on providers who have high values for both Medicare practice volume and the overpriced procedure share. It should be easiest to detect provider responses by examining the behavior of providers with relatively large Medicare practices and performing the overpriced procedures at a relatively high rate. Alternatively, a simple multivariate model could correlate various impact indicators (e.g., the rate of "substitute" procedures) to the actual values of (1) and (2), as well as to the provider-specific magnitude of the fee reduction.

A provider-level analysis would investigate impacts on the following variables:

- the annual number of overpriced procedures,
- the annual number of related (i.e., substitute) procedures,
- the annual number of major, unrelated procedures,
- the annual number of office visits,
- annual Medicare revenues,
- annual RVS-weighted service intensity, and
- the annual number of Medicare patients.

Comprehensive practice profiles could be constructed for individual physicians providing each of the overpriced procedures.

Several different econometric strategies are possible. The conventional alternative would be to pursue a pooled cross section-time series analysis, pooling observations for the same physicians over multiple time periods. If this were done, a "fixed effects" specification--wherein a dummy variable is included for each physician--could be used to control for unobserved differences in practice mix (i.e., omitted variables), and thereby minimize bias with respect to coefficient estimation for the included variables.

If, however, the time series is comparatively short (e.g., no more than three or four years), a "first-difference" analysis should provide reasonably equivalent results (and do so at a considerable savings of data development costs). For example, if one had only a three-year time series (e.g., 1987, 1988 and 1989), one could probably do just as well by analyzing differences between the two end points (i.e., the difference between 1989 and 1987). With either alternative, the "errors-in-variables" problem associated with a short time interval is usually severe, although (under reasonable assumptions) it should be somewhat less dominant in the first-difference model.

Both alternatives above (implicitly) assume that physicians achieve equilibrium in each year, fully adjusting practice behavior on a contemporaneous basis to reimbursement rate changes. If this "heroic" assumption is not valid, the analyses indicated above may seriously underestimate the long-run effects of physician fee reductions. For this reason, we strongly recommend investigating the importance of a dynamic or disequilibrium adjustment process.

Consider that physician behavior involves a **partial adjustment** process as follows. For each physician, his or her equilibrium or "desired" value Q^* , is not directly observable, but, over time, its actual level, Q^t , converges systematically towards the desired level. The adjustment is not complete in any given year, however, because of informational constraints and habit persistence. Positing a geometric lag distribution for the partial adjustment process (see Kmenta, 1971), we add a lagged dependent variable, Q^{t-1} , to the econometric model and estimate a "dynamic adjustment coefficient" (λ).

The dynamic adjustment coefficient provides a direct, quantitative measure of the relative rate of adjustment. The partial adjustment model assumptions imply that λ varies between 0 and 1. If $\lambda = 0$, no lagged adjustment is indicated, implying that equilibrium is achieved on a contemporaneous, year-to-year basis. However, as λ approaches one, the duration of the adjustment process increases without limit.

A provider-level analysis would unquestionably involve additional complexity. However, a deeper understanding of the individual provider's response to fee reductions is desperately needed in the present policy environment. Although better data (i.e., using UPINs) should be available in the near future, it is not clear that policy makers can afford to wait for new experience to accumulate.

TABLE 16-1

NUMBERS OF SOLO PRACTICE PHYSICIANS MATCHED BY CARRIER, 1986 TO 1989, BMAD PROVIDER FILE

<u>Carrier</u>	<u>Number of Matches</u>
Alabama	105
Arkansas	62
Louisiana	118
California	471
Colorado	93
Delaware	11
Washington, DC	116
Florida	731
Indiana	12
Iowa	93
Michigan	332
Minnesota (Rural)	14
Kansas City	21
New York (Upstate)	146
New York (Downstate)	1,447
North and South Dakota	23
Pennsylvania	332
Texas	895
Washington	84
Wisconsin	9
Puerto Rico/Virgin Islands	123
California (Southern)	413
Idaho	12
Tennessee	9
Wyoming	3
Connecticut	90
Minnesota	9
Mississippi	44
Virginia	68
Missouri (Excluding Kansas City)	81
New York (Queens)	1
Ohio	220
West Virginia	41
TOTAL	6,629

TABLE 16-2

NUMBERS OF SOLO PRACTICE PHYSICIANS MATCHED BY SPECIALTY, 1986 TO 1989, BMAD PROVIDER FILE

<u>Specialty</u>	<u>Number of Matches</u>
General Practice	637
General Surgery	438
Allergy	39
Otology, Laryngology, Rhinology	127
Anesthesiology	315
Cardiovascular Disease	192
Dermatology	140
Family Practice	654
Gynecology (Osteopaths Only)	1
Gastroenterology	79
Internal Medicine	1,153
Manipulative Therapy (Osteopaths Only)	4
Neurology	121
Neurological Surgery	54
Obstetrics (Osteopaths Only)	2
Ob-Gynecology	485
Ophthalmology, Otology, Laryngology, Rhinology (Osteopaths)	9
Ophthalmology	320
Orthopedic Surgery	254
Pathologic Anatomy; Clinical Pathology (Osteopaths Only)	48
Pathology	2
Peripheral Vascular Diseases or Oral Surgery (Osteopaths Only)	94
Plastic Surgery	54
Physical Medicine and Rehabilitation	437
Psychiatry	3
Psychiatry, Neurology (Osteopaths Only)	15
Proctology	68
Pulmonary Diseases	162
Radiology	2
Roentgenology, Radiology (Osteopaths Only)	2
Radiation Therapy (Osteopaths Only)	68
Thoracic Surgery	139
Urology	3
Nuclear Medicine	63
Pediatrics	2
Geriatrics	39
Nephrology	3
Hand Surgery	1
Single Specialty Clinic	1
TOTAL	6,629

REFERENCES

- Campbell, Donald T. and Julian C. Stanley. Experimental and Quasi-Experimental Designs for Research, Chicago: Rand McNally, 1963.
- Congressional Budget Office (CBO). Volume Responses to Exogenous Changes in Medicare's Payment Rates, Technical Memorandum prepared by CBO, August 1989.
- Cromwell, Jerry and Janet B. Mitchell, "Physician-Induced Demand for Surgery," Journal of Health Economics, 5:293-313, 1986.
- Department of Health and Human Services (DHHS), HCFA, Fee Schedule for Physicians' Services: Final Rule, Federal Register, 56:59502-59819, November 25, 1991.
- Fuchs, Victor, R., "The Supply of Surgeons and the Demand for Surgical Operations," Journal of Human Resources, 13:35-56, 1988.
- Gabel, Jon R. and Thomas H. Rice, "Reducing Public Expenditures for Physician Services: The Price of Paying Less," Journal of Health Politics, Policy and Law, 9:595-609, Winter 1985.
- McCarthy, Thomas R., "The Competitive Nature of the Primary-Care Physician Services Market," Journal of Health Economics, 4:93-117, 1985.
- Rice, Thomas and Nelda McCall, "Changes in Medicare Reimbursement in Colorado: Impact on Physicians' Economic Behavior," Health Care Financing Review, 6:33-42, Summer 1984.
- Wilensky, Gail R. and Louis F. Rossiter, "The Magnitude and Determinants of Physician-Initiated Visits in the United States," in Vander Gaag and Perlman, Eds., Health Economics, and Health Economics, North Holland Press, 1981.

APPENDIX A

PARTICIPATING CONSULTANTS

APPENDIX A
LIST OF CONSULTANTS

The authors wish to thank the following physicians for participating in the interview phase of this project:

John Hansen-Flaschen, M.D.
Pulmonary Medicine
Private Practice, Bala Cynwyd, PA

F. Christian Hansen III, M.D.
Gastroenterology
Private Practice, Baltimore, MD

Susan Hellerstein, M.D.
Obstetrics & Gynecology
Beth Israel Hospital, Boston, MA

Anthony N. Kalloo, M.D.
Gastroenterology
Johns Hopkins Hospital, Baltimore, MD

Ellen C. Maitin, M.D.
Orthopedic Surgery
Private Practice, Philadelphia, PA

Gary W. Muller, M.D.
Orthopedic Surgery
Private Practice, Philadelphia, PA

Michael Naslund, M.D.
Urology
University of Maryland Hospital, Baltimore, MD

Vikas Saini, M.D.
Cardiology
Private Practice, Hyannis, MA

Oliver Schein, M.D.
Ophthalmology
Johns Hopkins Hospital, Baltimore, MD

APPENDIX B

*NUMBER OF PROCEDURES
BY STATE*

TABLE B-1

TOTAL NUMBER OF PROCEDURES BY STATE: TOTAL HIP REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	1,095	1,118	1,200	1,186	1,027
Arizona	1,122	1,049	1,119	1,254	1,165
Connecticut	644	674	859	873	884
District of Columbia	517	542	586	561	525
Georgia	1,106	1,175	1,266	1,233	1,301
Kansas	530	509	720	814	783
Kansas City	595	631	693	739	633
New Jersey	1,688	1,765	1,648	1,773	1,436
Oklahoma	878	722	911	893	1,002
Oregon	795	988	909	1,046	1,059
Pennsylvania	3,749	4,040	4,020	3,979	3,999
Washington	1,400	1,608	1,730	1,660	1,702
Total	14,119	14,821	15,661	16,011	15,516

Source: Medicare Part B claims from eleven states.

TABLE B-2

TOTAL NUMBER OF PROCEDURES BY STATE: TOTAL KNEE REPLACEMENT

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	643	725	917	1,099	1,191
Arizona	926	1,041	1,154	1,437	1,545
Connecticut	348	405	600	716	792
District of Columbia	241	334	340	402	439
Georgia	770	940	1,037	1,301	1,472
Kansas	631	742	876	1,096	1,177
Kansas City	548	594	726	744	747
New Jersey	823	891	882	1,162	1,185
Oklahoma	740	797	972	1,131	1,403
Oregon	628	653	781	888	959
Pennsylvania	3,274	3,726	4,100	4,558	5,218
Washington	1,036	1,201	1,402	1,552	1,630
Total	10,608	12,049	13,787	16,086	17,758

Source: Medicare Part B claims from eleven states.

TABLE B-3

TOTAL NUMBER OF PROCEDURES BY STATE: KNEE ARTHROSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	0	310	377	478	519
Arizona	262	299	431	494	629
Connecticut	175	201	309	317	354
District of Columbia	1	117	151	155	177
Georgia	397	440	494	465	594
Kansas	101	111	117	120	159
Kansas City	2	117	134	202	224
New Jersey	130	341	477	510	620
Oklahoma	18	135	265	309	391
Oregon	376	392	475	572	588
Pennsylvania	11	817	1,209	1,214	1,337
Washington	1	416	639	645	809
Total	1,474	3,696	5,078	5,481	6,401

Source: Medicare Part B claims from eleven states.

TABLE B-4

TOTAL NUMBER OF PROCEDURES BY STATE: BRONCHOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	4,027	4,197	4,152	4,650	4,347
Arizona	2,940	2,687	2,822	2,848	2,695
Connecticut	1,372	1,468	1,806	1,854	1,770
District of Columbia	1,293	1,293	1,284	1,275	1,434
Georgia	4,353	4,666	4,720	4,412	4,548
Kansas	1,689	502	1,579	1,646	1,539
Kansas City	2,326	2,277	2,202	2,185	2,245
New Jersey	6,816	6,569	6,040	5,860	5,786
Oklahoma	2,070	2,051	1,920	1,821	2,095
Oregon	1,416	1,671	1,603	1,757	1,788
Pennsylvania	11,597	11,654	11,544	10,938	11,091
Washington	2,811	2,933	2,870	2,875	2,865
Total	42,710	41,968	42,542	42,121	42,203

Source: Medicare Part B claims from eleven states.

TABLE B-5

TOTAL NUMBER OF PROCEDURES BY STATE: PERMANENT PACEMAKER INSERTION

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	1,219	1,135	1,145	1,198	1,308
Arizona	568	607	729	826	858
Connecticut	636	596	753	848	987
District of Columbia	460	486	500	457	406
Georgia	778	1,479	1,605	1,826	1,926
Kansas	582	570	625	628	586
Kansas City	587	607	589	596	568
New Jersey	2,755	2,705	2,713	2,843	2,637
Oklahoma	1,202	1,226	1,222	1,211	1,128
Oregon	396	490	458	492	521
Pennsylvania	4,161	4,225	4,416	4,472	4,408
Washington	911	993	946	936	904
Total	14,255	15,119	15,701	16,333	16,237

Source: Medicare Part B claims from eleven states.

TABLE B-6

TOTAL NUMBER OF PROCEDURES BY STATE: CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	1,911	2,106	2,380	2,505	2,515
Arizona	1,268	1,095	1,348	1,406	1,561
Connecticut	667	934	1,394	1,466	1,549
District of Columbia	583	605	637	708	762
Georgia	1,564	1,778	1,892	2,201	2,320
Kansas	770	725	810	802	1,021
Kansas City	701	757	753	932	911
New Jersey	1,052	1,840	1,929	2,293	2,847
Oklahoma	1,408	1,145	1,499	1,582	1,533
Oregon	637	943	827	1,208	1,271
Pennsylvania	4,629	5,406	6,483	7,144	8,055
Washington	1,510	1,758	2,126	2,207	2,144
Total	16,700	19,092	22,078	24,454	26,489

Source: Medicare Part B claims from eleven states.

TABLE B-7

TOTAL NUMBER OF PROCEDURES BY STATE: UPPER GI ENDOSCOPY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	11,382	14,454	16,846	19,885	20,945
Arizona	6,380	6,716	8,162	9,544	10,256
Connecticut	5,627	6,120	8,358	8,683	8,915
District of Columbia	4,532	4,863	5,368	6,039	6,473
Georgia	12,609	14,430	17,482	16,126	20,457
Kansas	4,484	4,979	5,725	6,592	7,100
Kansas City	7,785	9,085	9,946	10,572	11,348
New Jersey	18,858	21,581	24,283	25,389	25,895
Oklahoma	7,632	7,690	9,657	11,671	12,793
Oregon	4,442	5,523	5,458	6,637	7,008
Pennsylvania	38,701	43,679	48,708	51,711	55,181
Washington	7,943	9,099	10,487	11,373	12,126
Total	130,375	148,219	170,480	184,222	198,497

Source: Medicare Part B claims from eleven states.

TABLE B-8

TOTAL NUMBER OF PROCEDURES BY STATE: TRANSURETHRAL PROSTATECTOMY (TURP)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	3,666	3,928	4,061	3,885	3,457
Arizona	3,118	2,996	3,172	3,125	3,184
Connecticut	2,145	2,249	2,812	2,671	2,518
District of Columbia	1,566	1,608	1,837	1,700	1,536
Georgia	4,700	4,832	5,244	4,977	4,332
Kansas	2,302	2,186	2,364	2,232	2,219
Kansas City	2,208	2,288	2,446	2,197	1,963
New Jersey	7,968	7,784	8,157	7,805	6,902
Oklahoma	3,090	3,062	3,584	3,454	3,270
Oregon	2,518	2,672	2,719	2,700	2,590
Pennsylvania	13,866	13,871	14,624	13,871	13,362
Washington	3,763	3,961	4,416	4,057	3,730
Total	50,910	51,437	55,436	52,674	49,063

Source: Medicare Part B claims from eleven states.

TABLE B-9

TOTAL NUMBER OF PROCEDURES BY STATE: SUBRAPUBIC PROSTATECTOMY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	150	145	127	101	89
Arizona	74	69	81	86	77
Connecticut	111	107	136	133	106
District of Columbia	75	84	96	67	72
Georgia	86	98	80	83	88
Kansas	57	57	48	33	34
Kansas City	36	25	32	30	20
New Jersey	437	400	397	331	296
Oklahoma	102	76	98	72	80
Oregon	37	33	40	37	49
Pennsylvania	440	362	376	260	304
Washington	91	99	82	76	76
Total	1,696	1,555	1,593	1,309	1,291

Source: Medicare Part B claims from eleven states.

TABLE B-10

TOTAL NUMBER OF PROCEDURES BY STATE: DILATION & CURETTAGE (D & C)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	876	862	799	834	774
Arizona	702	657	668	766	815
Connecticut	577	584	694	708	738
District of Columbia	355	377	410	400	433
Georgia	1,004	1,028	1,099	880	1,175
Kansas	554	530	631	510	574
Kansas City	423	432	466	438	402
New Jersey	567	1,430	1,566	1,515	1,490
Oklahoma	728	641	708	740	719
Oregon	465	560	513	606	575
Pennsylvania	3,470	3,629	3,625	3,565	2,175
Washington	928	966	918	944	863
Total	10,649	11,696	12,097	11,906	10,733

Source: Medicare Part B claims from eleven states.

TABLE B-11

TOTAL NUMBER OF PROCEDURES BY STATE: CARPAL TUNNEL RELEASE

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	500	497	653	775	860
Arizona	600	555	621	766	879
Connecticut	559	585	774	954	1,028
District of Columbia	197	235	273	243	298
Georgia	423	512	639	504	797
Kansas	411	488	539	607	662
Kansas City	444	475	496	563	613
New Jersey	979	1,041	1,122	1,220	1,284
Oklahoma	456	409	514	615	683
Oregon	619	682	732	782	862
Pennsylvania	3,378	3,656	4,040	4,595	4,753
Washington	1,009	1,088	1,256	1,474	1,402
Total	9,575	10,223	11,659	13,098	14,121

Source: Medicare Part B claims from eleven states.

TABLE B-12

TOTAL NUMBER OF PROCEDURES BY STATE: CATARACT SURGERY

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Alabama	13,505	15,526	17,401	18,931	18,701
Arizona	16,384	16,476	16,324	18,532	17,222
Connecticut	7,902	7,712	10,489	11,711	12,343
District of Columbia	6,434	7,302	7,192	7,606	7,657
Georgia	18,238	20,203	21,778	18,356	24,329
Kansas	6,108	6,823	7,918	8,704	9,300
Kansas City	9,049	9,809	10,462	10,929	9,899
New Jersey	23,266	27,492	29,904	30,241	26,776
Oklahoma	12,506	13,616	16,425	17,147	17,445
Oregon	9,996	10,591	9,700	10,371	10,513
Pennsylvania	44,946	49,570	51,169	51,433	52,656
Washington	13,154	16,266	19,040	19,868	18,264
Total	181,488	201,386	217,802	223,829	225,105

Source: Medicare Part B claims from eleven states.

CMS LIBRARY



3 8095 00012819 5